EIGHTEENTH YEAR

Railway Age

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Railway Age
and
Railway Engineering and Maintenance
DAILY EDITION

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Contents

EDITORIALS

MISCELLANEOUS

A. R. E. A. PROCEEDINGS

NEW DEVICES

Have You Seen the Exhibit?

THIS is the last day of the exhibit of the National Railway Appliances Association at the Coliseum. It is well worth seeing. Statements to the effect that this or that convention or exhibit is bigger and better than that of any previous year are not taken seriously; they have become trite. However, insofar as the N. R. A. A. is concerned, it may be said without contradiction that its exhibitor members have been alert to take advantage of developments in the art of display. The showing of actual specimens or samples as contrasted with small scale models have always been the rule at these exhibits, but in recent years these have been supplemented by demonstrations of use, by moving pictures, scenic effects and the like. Taken all together, the show evinces improved technique in showmanship. If you have not seen it, you have missed something.

Why Not a List of Past Officers?

THE A. R. E. A. was organized for the study of technical problems. Yet there is a human side to participation in its work. Furthermore, the Association is now old enough to have its traditions. Its charter members and the officers of past years include many men who have attained distinction not only in railway affairs but also in the country at large. Every loyal member, therefore, owes it to the Association and to himself to learn something of the Association's history and of the distinguished personnel of past years. However, he is distinctly handicapped in any efforts to this end because of the paucity of such information in any of the current publications of the Association. A tabular statement of the officers and directors, in chronological order, published in the annual proceedings or in the membership bulletin would be of interest to all members and afford a convenient means of reference.

Wanted, More General Discussion

WITH a convention hall large enough to accommodate all who want to attend the sessions of the convention, the A. R. E. A. has found the solution of one of the problems that has confronted it for a number of years. Noise in the ante-room and unsatisfactory acoustics are matters that remain to be dealt with but there is another feature of the convention procedure that is still far from satisfactory—the participation of the members in the discussion. A rough analysis of the proceedings on Tuesday showed that not more than 25 members had anything to say from the floor, exclusive of the chairmen of committees or subcommittees whose business it was to present their reports. Of those who spoke, one spoke five times, three spoke four times and three three times. If the remarks of these seven men had been excluded the amount of discussion from the floor would have been exceedingly small. Considering the number present this is not a good showing.

An Indication of Progress

AN example of the manner in which the American Railway Engineering Association meets new conditions has been afforded by the way in which it has changed the name of the old Committee on Signs, Fences and Crossings to that of Grade Crossing Design, Protection and Elimination. Furthermore, this committee has shown a realization of the importance of the subject and of the far-reaching results that may be secured. The grade crossing problem has risen rapidly and with it the widespread demand for wholesale grade separation. With some 250,000 grade crossings in this country and the cost of separating them variously estimated at from $12,000,000,000 to $20,000,000,000, it is apparent that the real problem facing the railways is not *how* to separate the crossings but rather how to *select* the crossings to be separated and how this work should be paid for. That the true significance of this problem has been realized by the committee is evident by its report this year on the laws and regulations affecting the apportioning of federal aid and the proper division of

the cost of separating grades as between the railways, the public and other corporations. Among other subjects which the committee is studying is the possibility of eliminating unnecessary or duplicate crossings and the economic aspects of grade crossing protection in lieu of grade separation. These subjects are of such timely and vital importance to the railways, and so far-reaching can be the effects of their proper handling, that this committee, which promises to become one of the most important in the Association, should be given the utmost support and co-operation by every member.

How Did It Make You Feel?

THE report of the Committee on Economics of Railway Labor with regard to winter work, presented at yesterday's session while the sun streamed through the windows, must have unconsciously brought a sense of satisfaction to many of the members of the Association who have behind them a winter of effective work and who can now look forward to their summer programs with a feeling that they have a summer ahead into which they do not have to crowd a full year's work. At the same time, the report must have aroused regrets in the minds of other members of the Association, who have seen an unusually open winter pass while their work was at a standstill. In its report the committee outlined 21 maintenance of way tasks which can be handled effectively during the winter months, and the committee is in a position to know that its recommendations are sound. In fact, there are an increasing number of railroad officers outside of the committee who have learned from actual experience that their recommendations are sound, for winter maintenance work in this country is now being carried on successfully by roads from the Mason and Dixon line to the Canadian border. It is true that the passing winter has been unusually favorable for effective winter work in many areas, but when was the winter that did not permit the carrying on to some extent, at least, of a majority of the tasks listed by the committee? The experience of past years has proved clearly that hard winters do not come every year, but on the other hand, that where winter work is not performed, long, hard, crowded summers invariably do. The committee is to be congratulated on its practical recommendations. We venture to say: Show the committee a road that gets all or most of this work out of the way during the winter and it will show you a road where the work on the whole is performed better and more economically, and where labor problems have been reduced to a minimum.

Operation of Watson-Parker Act

THE address made by Chairman Winslow of the Mediation and Conciliation Board at the dinner last night seems to imply, although probably this was not intended, that the measure of the success of the Watson-Parker Railway Labor Act is the extent to which it prevents strikes. This is not and should not be the only purpose, or perhaps even the main purpose, of a law for the settlement of railway labor disputes. The setttlement of a dispute should not only prevent a strike, but should also result in the fixing of fair wages and working conditions. The public is not only entitled to have interruptions of railway service avoided, but to have service rendered at a reasonable cost. Wages are so large a part of operating expenses that cost of service cannot be reasonable unless wages are reasonable. A settlement of a dispute that avoids a strike at the cost of an excessive advance in wages may in the long run be more expensive to the public than a strike. The strike of shop employees against the wage award of the Railroad Labor Board in 1922 was expensive, but much less so than continuance of the wages and working conditions for which the employees struck would have been. No rational conclusion regarding the real value of the Railway Labor Act can be drawn from a statement of facts which shows peaceful settlements but which does not indicate whether the settlements were fair and reasonable. The arbitration of the wage dispute of the eastern railways with their conductors and trainmen resulted in a peaceful settlement, but there is serious question as to whether the wage advance in which it resulted was not excessive. The same wage advance was granted by the southeastern railways after a strike vote had been taken. A settlement made following a strike vote may be euphemistically called "peaceable," but one who can regard the settlement finally made in this instance, which was not a result of arbitration or actually voluntary on the part of the railways, as a triumph for the Watson-Parker Act must believe that peace at any price is the main or sole purpose of the law. As long as strike votes are resorted to as in this case, the settlements that follow will have to be largely regarded as due to "economic pressure"—in other words, threats of strikes—rather than to the operation of the Watson-Parker Act.

A Study of Timber Utilization Is Needed

THE railways consume 26 per cent of the forest products of the nation and, being among the largest users of timber and lumber, have a vital interest in maintaining a dependable supply, both in the immediate future and for all time. In view of the rapid depletion of the forests of the United States and Canada, it has been suggested that the American Railway Engineering Association should take cognizance of the situation and appoint a special committee to investigate those questions which relate to forests and forest products, and instruct it to formulate recommendations for the guidance of the railways to the end that they may co-operate intelligently and efficiently with other agencies which are seeking to bring about a policy of forest conservation, in such a way as to insure a permanent supply of timber for their own use.

This need not be a permanent committee, because, having once formulated its recommendations, its work will have been finished until new conditions arise, but its instructions should be such as to give it wide latitude and permit it to go into every phase of greater production, better utilization and intelligent co-operation with other agencies which are working toward the same objective. There is a wide field in which it can work to advantage, and while it should go into the question of forest conservation, including the forestation or reforestation of large tracts of land owned by the railways, other corporations and private interests, down to the wood lot on the farm, there are other matters relating to utilization which are of equal importance.

As a suggestion, these might include a study of the uses of timbers, and of the timbers best adapted to the various uses of the railways. There are many inferior woods which a study might develop could

be substituted in some instances for the better grades of timber now used, and any such substitution would be an excellent form of conservation. Increased use of treated timber is also possible in structures such as ice houses, shops and other buildings, and in cars.

Then, again, on the American railways second hand timbers generally are not regarded highly, and here is a field where much could be done. As an example, in England, where timber is scare, treated ties are first applied to high speed tracks and after years of service they are transferred to slow speed freight tracks, and later used in sidings. When they are removed from side tracks they are not piled up and burned as is done in this country, but are sawed lengthwise and used for fence posts.

This committee might also study the subject of substitutes for wood in many forms of construction, not from the viewpoint of permanent construction, because this frequently means added investment which is not warranted from an economic standpoint, but to relieve in some measure the pressure of the demand on the forests. This work should also include the questions of education and legislation affecting the general program for insuring a continuing and adequate supply of timber for the future.

The need for intelligent co-operation on the part of the railways is urgent, and the American Railway Engineering Association seems to be the organization best fitted to make such a study and formulate recommendations for them.

The A.R.E.A. and the Depreciation Order

THE Interstate Commerce Commission has issued an order requiring the railways to institute a system of depreciation accounting for roadway and structures the far reaching effects of which are not yet appreciated by all engineers. In its order the commission requires each road to advise it by September 1 how it expects to comply with this order and the rates of depreciation which it proposes to establish for each unit of its property. The complexity of this problem, even when confined to a single item of engineering construction, rail, was set forth clearly by C. A. Morse in a letter published in the *Railway Age* of February 19, page 534.

Engineers are commonly inclined to look on depreciation as a problem solely for the accountant and the valuation man. Yet this order strikes at the very heart of the railways' investment in their fixed properties. No one is as thoroughly informed regarding this class of railway property as the construction and maintenance engineer and he cannot, in justice to his road, ignore the subject. It is doubtful if his management will permit him to do so if he desires. He is, therefore, facing a very real problem. Under this condition it would appear that the A. R. E. A. has a new opportunity for service to its members. While it is true that the order was issued only recently it is also true that railway men are soon going to be forced to give it thought, and a discussion of the requirements of this order would be very helpful and would do much to crystalize thought. Since no steps have been taken to give consideration to this subject at the meeting, it would seem important that the board of direction should consider giving concerted attention to the problem at the earliest possible date in order that the members may receive as much aid as possible in studying the commission's order.

Announcements

The A. R. E. A. Program for Today

THIRD DAY, Thursday, March 10

Yards and Terminals	Bulletin 294
Buildings	Bulletin 294
Wooden Bridges and Trestles	Bulletin 293
Wood Preservation	Bulletin 295
Uniform General Contract Forms	Bulletin 293
Masonry	Bulletin 295
Roadway	Bulletin 295
Co-operative Relations with Universities	Bulletin 295
Stresses in Railroad Track	Bulletin 295

Clearances—Progress Report.
New Business.
Election and Installation of Officers.
Adjournment.

* * *

Through the courtesy of the Illinois Central, a special train will leave the Randolph street suburban terminal at 9 o'clock Friday morning for an inspection of the Illinois Central electrified zone. The train will stop at Van Buren and 12th Street suburban stations outbound and will proceed to the southern limits of the electrified territory at Matteson, 28 miles south, returning to Randolph street at 1 p. m. On the outbound trip the party will stop at Brookdale (67th street) to look over the South Chicago branch underpass and other grade separation work and to go through the sub-station where the Public Service Company's a-c. current is converted into direct current for traction purposes. This station has both the mercury arc and rotary type converters. A stop of about an hour will also be made at Hazel Crest to afford an opportunity for the inspection of the car retarders in Markham Yard.

News

Charles W. Gennett, Jr., manager rail inspection department, Robert W. Hunt Company, and an active member of the Rail committee will present a paper on rails before the New England Railroad Club on April 12.

* * *

C. E. Smith, consulting engineer, St. Louis, Mo., has been retained by the Public Service Commission of Louisiana to make a report on the future passenger station development at New Orleans considering particularly the question whether one or two stations should be provided in that city.

* * *

Among the construction contracts awarded this week are the following: The Baltimore & Ohio has awarded a contract to the Vang Construction Co., Cumberland, Md., for grading and masonry on a new viaduct from Germantown, Pa., to Barnesville, Md., and a contract to the Empire Construction Co., Baltimore, Md., for additional track work in connection with this project, the cost being estimated at $1,650,000; the Central of Georgia has awarded a contract to the U. G. I. Contracting Co., Atlanta, Ga., covering the construction of a reinforced concrete and steel viaduct at Savannah, Ga., estimated to cost $480,000. The Pennsylvania has awarded a contract to Sinclair & Grigg, Philadelphia, Pa., covering the construction of buildings, platforms and shelters at South Philadelphia and a perishable products terminal at Baudales street and Oregon avenue, Philadelphia, to cost about $500,000. The Pennsylvania is also drawing up plans and specifications for a two-track bridge over Newark Bay from Greenville, N. J., to Newark, to cost about $3,000,000. This bridge is to be of concrete and structural steel and it is expected that bids will be asked in about 30 days.

The Coliseum, Where the N. R. A. A. is Exhibiting

M. S. Ketchum, dean of the college of engineering at the University of Illinois, was once a student at that university. A classmate of his was named Killam, and they were frequently seen together, being known as the Ketchum and Killam boys.

* * *

Did you see that verse "To the Old Guard" on the banquet program last night? Paul J. Powers, chief clerk to the engineer maintenance of way of the Delaware & Hudson wrote it and it appeared in the *Railway Age* of February 5. Another verse from Mr. Powers' metrical pen appeared in the February 26 issue.

* * *

It is hardly likely that G. A. Wells, recently appointed chief engineer of the Georgia, Florida & Alabama, will spend much time in jail while he is at the convention, regardless of any crimes he may or may not commit. Mr. Wells is the son of Hosea Wells, judge of the Superior Court in Chicago. With the involved traffic rules in this city one can never tell when one will need a friend in court.

* * *

L. P. Rossiter, who has been division engineer of the Lehigh Valley, with headquarters at Buffalo, N. Y., arrived at the convention with a new title. Mr. Rossiter is now assistant engineer of grade crossing elimination of that road and will have charge of the work in the state of New York, made necessary by the recent grade crossing law passed in that state. E. J. Cullen, division engineer at Sayre, Pa., succeeds Mr. Rossiter at Buffalo; R. E. Patterson, division engineer at Hazleton, replaces Mr. Cullen at Sayre; H. M. Fearon, division engineer at Auburn, relieves Mr. Patterson at Hazleton, and A. B. Shimer, track supervisor at Sayre, has been promoted to division engineer at Auburn, succeeding Mr. Fearon.

* * *

The Armco Culvert and Flume Manufacturers' Association has opened a district office at Lincoln, Neb., with Mont C. Noble, former chief of the bureau of roads and bridges, Nebraska State Department of Public Works, as district engineer in charge. This office will be in charge of association work in Nebraska, Kansas, Iowa, and Missouri. A district office has been opened also at East Point, Ga., with Tom M. Neibling, former research engineer for the Georgia State Highway Department, as district engineer in charge. This office will be in charge of association work in Alabama, Florida, Georgia, Louisiana, Mississippi, Tennessee, North Carolina and South Carolina.

Names Is Names

Chapter III

The third installment of this engrossing serial finds us among the tradesmen. Among the members of the convention there are no Barbers, but there is one Shaver. Eight Cooks, with a few scattering Cookes, take care of the kitchen, while there are three Banks to take your money. Among the servants of the house is one Butler, four Porters and several Stewarts, and one Carver completes the kitchen staff with one Baker. There are five Carpenters and one Pflasterer, working with one Wheelwright, one Sawyer and one Turner. There is a Sadler, a Currier and a Carter to take care of the horses. The clothes for the Association are taken care of by a Draper, a Glover, a Weaver and a Taylor. The wheat is ground by three Millers, and the wool is grown by two Shepherds. In case one of the members commits a crime, there is a Warden to look after him when he is in jail. One Harper furnishes the music for the crowd. Baseball is represented by a Pitcher, a Thrower and a Ball, and for those who wish to go to sea, there is one Shipman ready to serve, with one Beacon to show the way on stormy nights.

(To be continued)

* * *

The hobby for collecting is practically universal. Nearly everyone has at some period in his life made a collection of this, that, or the other thing, paints, postage stamps, antiques, old coins, hunting and fishing trophies and tackle—the list is almost endless. The new president of the A. R. E. A., D. J. Brumley, has the collection trait in common with most of the rest of mankind, but in his case it takes a rather unusual form. Mr. Brumley collects garden tools. It is reported that his collection of weed pullers, rakes and hoes is one of the most complete in existence. Mr. Brumley does not stop at collecting the tools either. He uses them. His garden at Flossmoor, Ill., just south of Chicago, is regarded as a model of its kind. The accompanying illustration shows Mr. Brumley and his son busily engaged in their favorite avocation. Mr. Brumley is regarded as an authority on gardening and is the co-author of a book on the subject.

Proving That President Brumley Knows His Onions

The Board of Directors Met on Monday

A. R. E. A. Has a Busy Second Day

Active interest in committee reports sustained throughout morning and afternoon sessions

THERE was no let down in the attendance or in the interest in the proceedings during the course of yesterday's sessions of the American Railway Engineering Association's twenty-eighth convention. The convention hall was well filled during the day and the discussion was active. Extended comments of a pertinent character were especially elicited by the report of the Committee on the Economics of Railway Location. Other reports presented and discussed included those of the committees on Water Service; Grade Crossing Design, Protection and Elimination; Economics of Railway Labor; Economics of Railway Operation; Iron and Steel Structures; Rail and Rules and Organization. As a special feature during the afternoon, moving pictures were presented showing the operation of car retarders as installed in various classification yards by the General Railway Signal Company and the Union Switch & Signal Company.

Report of the Committee on Water Service

Most of the reports of this committee were presented with the request that they be received as information and reassigned for further study and report. One of the important tasks of the committee was the formation of revised general principles of water supply to replace material at present in the Manual on this subject. Among the reports submitted were those on the use of gravity and pressure filters, the disposal of sludge at water softening plants, the design of track pans, wells in fine sand formation, drinking water supplies, pitting and corrosion of boiler tubes and sheets, heating of water station buildings, and duplicate and standby pumping units. C. R. Knowles has been chairman of this committee for 4 years and a member for the past 11 years.

C. R. Knowles
Chairman

THE committee on Water Service presented reports on the following subjects: (1) Revision of the Manual (Appendix A). (2) Drinking Water Supplies on Trains and Premises of Railways (Appendix B). (3) Pitting and Corrosion of Boiler Tubes and Sheets (Appendix C). (4) Value of Water Treatment and Comparison of Methods (Appendix D). (5) Heating Water Station Buildings (Appendix E). (6) Duplicate and Standby Pumping Units (Appendix F), and (7) Spacing of Water Stations (Appendix K). It reported progress on the subjects of (8) Gravity and Pressure Filters (Appendix G). (9) Disposal of Sludge (Appendix H). (10) Design of Track Pans (Appendix I), and (11) Wells in Fine Sand

Formation (Appendix J).

It recommended the following action on its report: (1) That the revised "General Principles of Water Supply Service" be accepted for publication in the Manual, substituting this report for pages 628-634, inclusive. It also recommended that "Instructions for Care of Water Stations," pages 645-654, be eliminated and that examination of the subject-matter in the Manual be again referred to the committee for further study and report. (2), (3), (4) That the following reports be received as information and the subject reassigned to the committee for further study and report drinking water regulations; the pitting and corrosion of boiler tubes and sheets; and the value of water treatment and methods followed in treatment of water. (5) That the report on heating water station buildings and frost protection for water facilities be accepted as information. (6) That the report on duplicate and standby pumping units be accepted as information, the conclusions to be accepted for publication in the Manual as a part of "The Principles of Water Supply." (7), (8), (9), (10) That the following subjects be reassigned to the committee for further study and report: Use of gravity and pressure filters; methods of disposal of sludge at water softening plants; design and maintenance of track pans for locomotive supply; and methods used in securing successful wells in fine sand formation. (11) That the progress report on the spacing of water stations and capacity of engine tenders be accepted as information and the subject reassigned to the committee for further study and report.

Committee: C. R. Knowles (I. C.), chairman; R. C. Bardwell (C. & O.), vice-chairman; C. M. Bardwell (M.-K.-T.), W. M. Barr (U. P.), S. C. Beach (I. C.), O. W. Carrick (Wab.), R. W. Chorley (Penna.), R. E. Coughlan (C. & N. W.), J. H. Davidson (M.-K.-T.), B. W. DeGeer (G. N.), E. A. Dougherty (N. Y. C.), J. M. Fitzgerald (C. of Ga.), E. M. Grime (N. P.), J. P. Hanley (I. C.), J. R. Hickox (C. B. & Q.), C. P. Hoover (City of Columbus, Ohio.), S. C. Johnson (C. & O.), C. H. Koyl (C. M. & St. P.), P. M. LaBach (C. R. I. & P.), E. G. Lane (B. & O.), W. B. McCaleb (Penna.), A. B. Pierce (So. Ry.), O. T. Rees (A. T. & S. F.), H. H. Richardson (M. P.), T. D. Sedwick (C. R. I. & P.), H. E. Silcox (C. & O.), D. A. Steel (Ry. Age), R. A. Tanner (N. P.), C. P. VanGundy (B. & O.), H. W. VanHovenberg (St. L. S. W.), F. J. Walter (N. C. & St. L.), A. E. Willahan (K. C. S.), F. D. Yeaton (C. M. & St. P.).

Appendix A—Revision of the Manual

Under this head the committee presented within 15 pages of the bulletin a revised statement of "General Principles of Water Service" which it recommended be substituted in the Manual for the present material on that subject. While the new statement incorporated a number of revisions of the old material in order to simplify it and bring it up to date, the main purpose of the committee in preparing the revised statement was to cover the subject more thoroughly, particularly with reference to the various types of pumping plants and pumping equipment, methods of installation, types of power to be used, relative economies, and water service pipe line, on which subjects considerable material was added.

It also presented a chart for use in calculating the frictional losses in cast iron pipe and fittings, and a short general statement on pump houses.

Appendix B—Federal Regulations Pertaining to Drinking Water Supplies

State health departments have been requesting of the railroads that stations classed as "emergency" drinking water stations be equipped with all apparatus used at regular drinking water stations, namely, the filling bucket with angled snout and completely decked over, 100 ft. of hose to be used to fill tanks with drinking water in case standard filling buckets were not available, dust-proof repositories for storage of buckets or filling hose when not in use for emergency filling purposes, protected taps or antifreeze hydrants and other devices which would be available in a regular drinking water filling station. It is also requested that such stations be cared for by the water department employees because of the constant use given such apparatus. To do this would involve an unjustifiable expenditure.

The committee again called attention to the Drinking Water Standards adopted by the United States Public Health Service in May, 1925, for the government of water supplies furnished by common carriers for the use of passengers in interstate traffic. These standards were prepared and adopted without consultation with or representation from the Association.

Among the requirements established by these standards for the physical and chemical characteristics of acceptable water supplies are the following: (1) The water should contain no caustic alkalinity; (2) The carbonates of sodium and potassium taken together should not exceed 0.50 ppm.; (3) Total solids should not exceed 1000 ppm.; (4) Chloride should not exceed 250 ppm.; (5) Iron should not exceed 0.3 ppm.; (6) Sulphate should not exceed 250 ppm.; (7) Magnesium should not exceed 100 ppm.

The committee contends that it is neither practical at all times for the railroad nor essential to public health to confine such water within the limits prescribed. It is frequently impracticable for railroads to provide drinking water meeting the above requirements except at unreasonable expense. Moreover it has not been definitely established in general that waters carrying solids in excess of the prescribed limit and particularly that waters having caustic alkalinity present are deleterious to health, except where there is reason to believe that they indicate contamination. On the contrary, it is known that many drinking supplies, municipal as well as railroad, carry solids in solution greatly in excess of the prescribed amounts without any established ill effects upon health of persons using them.

Until such time as it shall have been definitely determined by adequate research what these limits must be to safeguard public health, it is recommended by the committee that these standards be applied with a liberal interpretation arrived at after a reasonable consideration of the local conditions and available supplies.

Appendix C—Pitting and Corrosion of Boiler Tubes and Sheets

This is a progress report to the effect that the work of accumulating extensive data on the subject is necessarily slow. A questionnaire was recently sent to various members of the committee requesting information on the subjects which had been assigned to them for the current year's work. Several replies were received but the committee did not feel that the data so far assembled warrant making any more detailed report at this time.

Appendix D—Cost of Impurities in Locomotive Water Supply and the Value of Water Treatment

In successive reports commencing in 1922 this subcommittee has presented evidence to show that:

(1) Between locomotives running in districts

with naturally good boiler water and locomotives running in districts with excessively bad water there is a difference of cost of boiler repairs and fuel of about $4,000 per engine per year and an additional difference in general operating costs of approximately $4,000 per engine per year; (2) By the use of water-softening methods now available to anyone some of these very bad water districts have had their boiler repair and fuel cost reduced $4,000 per engine per year and their operating cost reduced in like amount; while districts with water less bad have had their costs reduced in proportion and at the rate of $1,000 per engine per year in repairs and fuel for each ten-grains-per-gallon of hardness in the water, and an equal amount in general operating expenses.

Nearly all river and well waters of the level country require treatment to remove either hardness or mud or both, and with approximately 16,000 railroad water stations and something like 350 billion gallons of water used annually by the railroads for locomotive purposes, of which about 80 per cent would be improved by treatment and only 15 per cent is treated, the most valuable contribution that can be made by this committee or this association to the water service of the railroads of the country is to make everyone acquainted with the fact so that an annual and unnecessary expense of something like $100,000,000 may be eliminated.

The Zeolite Method.—Last year we discussed the various methods for water softening in use on railroads, and mentioned the zeolite method as suitable for certain kinds of water and as being tested by the Southern Pacific at Los Angeles, Cal. We are now advised by Dennistoun Wood, engineer of tests, that this railroad has found the zeolite method satisfactory for stationary boilers and locomotives, that zeolite softeners have been installed at five points with five similar plants under construction at other points and the report says "With the plants already installed we are experiencing practically no trouble from foaming."

Carbonate and Sulphate Scales.—The relative insulating qualities of carbonate and sulphate scales; is difficult of experimental determination in locomotives because they seldom take one kind of water only, and the best laboratory measurements of which we have knowledge are those made by Professor Schmidt at the University of Illinois, as follows:

Character of Scale	Thickness	Composition	Per Cent Loss
Hard	1/50 in.	Mostly Carbonate	5.4
Soft	1/32 in.	Mostly Carbonate	7.2
Hard	1/32 in.	Mostly Carbonate	8.5
Soft	1/25 in.	Mostly Carbonate	8.0
Hard	1/25 in.	Mostly Sulphate	9.3
Hard	1/20 in.	Mostly Sulphate	11.1
Soft	1/16 in.	Mostly Sulphate	10.8
Soft	1/16 in.	Mostly Carbonate	11.0
Soft	1/16 in.	Mostly Carbonate	12.4
Hard	1/16 in.	Mostly Carbonate	12.6
Soft	1/11 in.	Mostly Carbonate	15.0
Hard	1/9 in.	Mostly Carbonate	15.9

From this it appears that the difference in heat losses between carbonate and sulphate scales per se is negligible and that the differences in insulating quality which are found are due rather to differences in density and mechanical structure.

Many careful calculations are on record to show that locomotive fuel losses in the United States on account of scale in boilers are not less than $50,000,000 per year, and the damage to boilers is as much more, these two items making up the $100,000,000 per year of unnecessary loss mentioned above, which can be rapidly reduced by a campaign of education.

Appendix E—Heating Water Station Buildings and Frost Protection for Water Facilities

Stove Heating.—Where steam generated outside the building is not available we believe the stove may continue to be used in water station buildings if it is used in connection with proper drainage of the water carrying facilities.

Furnace Heating.—The hot air furnace follows the stove in cheapness of installation. Small furnaces are now being placed on the market at reasonable prices and in attractive designs, and are an advancement over the stove for heating water station buildings. These furnaces are built with or without air ducts, depending on the size of the building to be heated. They provide a better circulation of warmer and purer air to all parts of the building, present a more attractive appearance, usually permit of longer periods between firing, and are more economical in operation than stoves.

Hot air furnaces have the advantage over steam and hot water heating to the extent that they are not damaged by freezing in case the fire is not given the required attention, and if they have ample fire box capacity they are capable of maintaining a banked fire with corresponding heat for as long a period as a steam or hot water heating plant, without unusual firing attention.

Steam and Hot Water Heating.—Steam heat may be used to good advantage where the building to be heated is located in the vicinity of mechanical or central power house facilities; and when used it should be installed in accordance with approved steam heating practice, including suitable traps and return lines.

Electric Heating.—The Illinois Central reports the use of electric heaters of the resistance type in heating water service facilities. The use of the heaters by this road consists of six 500-watt heaters, having the control switch located in a station office adjacent. We do not recommend this method for general use on account of its relatively high operating cost.

Oil Heating.—The Chicago, Burlington & Quincy reports the use of heating plants fired by oil, and the use of oil stoves at several water stations. The use of oil instead of coal at these locations removes the expense of calling men at night to keep the fires in proper condition. The cost of the burner, piping and 1,000-gal. capacity oil tank, which is suitable for the average water station heating unit, is approximately $180.

Housing and Insulation.—Water station buildings in cold climates should be well constructed of sound materials. The frost resisting qualities of the materials should be considered as well as their strength and durability. Unfortunately some of the strongest and most durable building materials are poor frost resisters; and in cases where the use of such materials are necessary frost proofing should be arranged for in addition, preferably by lining the inside of the building with hollow tile, lumber or other materials in sufficient courses to give the required degree of frost resistance.

The roofs of the buildings should be constructed with multiple courses of sheathing, and storm doors and shutters should be provided. Floors should be constructed so that cold air will not come in contact with them underneath. Fuel storage should be conveniently located and the ash removed from the

plant should be deposited at a safe distance from the buildings. Suitable ventilation should also be provided, especially in plants where oil or gasoline is used for fuel or power.

Ice Prevention in Water Tanks.—The accumulation of ice in water tanks occurs in varying degrees and should be provided for accordingly. It may be ignored or tolerated where it occurs in moderate amounts, but where it interferes with operation it should be overcome by housing or heating. A common type of heating plant is on having heating coils and a smoke pipe passing through the water in the tank. Where it is not desired to install a heating plant considerable diminution in ice deposits may be effected by suitable housing and insulation.

Many railroads using wooden tanks in cold sections located the outlet valve and inlet pipe near the center of the tank and enclose the tank bottom at this point in the under side by the top section of the frost box, which is made of ample size for this purpose. This location is safer from ice encroachment from the sides, and the protection afforded by the frost box underneath prevents, or materially decreases, the thickness of the ice deposits on the tank floor, with corresponding improvement in tank valve and inlet pipe operation.

Heating Water Tanks.—The heating of tanks by direct contact of the water in the tank and the heating medium is the method generally used. This method sometimes results in over-heating, and we believe there are many instances in moderately cold sections where sufficient frost protection could be obtained by housing the tank or such parts of it as require housing and heating the interior of the housing to a safe temperature.

Water Column Pits.—The Illinois Central operating in northwestern Iowa covers the outside, top and sides of the pit with one course of ship-lap lumber carried to a point in the ground slightly below the frost line, and uses two courses of D & M lumber with an air space between courses on the inner walls and ceiling of the pit. Both inside and outside sheathing have hatch covers made of similar lumber to protect the opening in the concrete top. The use of this frost proofing at the locations mentioned stopped the penetration of white frost that was previously noticeable on the inside of the concrete walls and improved the operation of the water columns by eliminating small freezing troubles in drain ports and valves. Cold air will enter water column pits through the ordinary type of open and tile drainage, where it will become warm enough to ascend and escape through the opening around the column, being then replaced by cold air through the drain. This air change may be prevented by a water seal made of an ordinary pipe elbow installed in the pit end of the drain and turned down into a small sump in the pit floor.

Cost Estimates of Various Heating Systems.—The committee stated that it was impracticable to give cost estimates which would cover all local conditions of heating, but in order to give an approximate comparison the estimates of the Illinois Central for the year 1926 were given covering the heating of one of its frame treating plant buildings with hot water, steam and hot air heat, and one of their brick pump houses with stove and hot air heat.

The portion of the treating plant heated consists of an equipment room, size 19 ft. by 17 ft. by 14 ft., and a head house above the settling tank, size 10 ft. by 10 ft. by 10 ft. The pump house consists of a single room having a cubical contents of approximately 8,500 cu. ft. The heating plants have sufficient capacity to give a room temperature of plus 70 deg. F. for an outside temperature of minus 20 deg. F. for the buildings mentioned—

Hot Water System in Treating Plant	
348 sq. ft. steam radiation with boiler and smoke connection to chimney, at $2.25	$ 783.00
Steam System in Treating Plant	
257 sq. ft. steam radiation with boiler and smoke connection to chimney at $2.25	578.25
Condensation pump in concrete pit	500.00
	$1,078.25
Hot Air System in Treating Plant	
Hot air furnace, 12,000 cu. ft. capacity	$ 275.00
Smoke connection to chimney	25.00
48 ft. 12 in. sheet iron duct	150.00
2 14 in. by 16 in. registers	10.00
	$ 460.00
Stove Heat in Pump House	
Stove with jack and smoke pipe	$ 90.00
Hot Air Heat in Pump House	
Hot air room heater with jack and smoke pipe	$ 150.00

Conclusions

(1) Frost protection may be affected by drainage, housing and heating, and each method should be used separately or in such combinations as local conditions require, after comparative estimates have been made to establish the most economical and suitable arrangement. These estimates should include interest and depreciation on the first cost as well as maintenance and operating expense for each arrangement considered.

(2) Stoves and hot air furnaces may be used for heating water station buildings where steam generated outside the building is not available. The furnace is an advancement over the stove that should be considered when such buildings are constructed in the future.

(3 Steam heat may be used to good advantage in the vicinity of power plants, but hot water heat is generally preferable at isolated locations. Sufficient continuity of attendance should be provided at the latter points to keep the fire in proper condition.

(4) Electric heating is generally too expensive in current consumption to be considered, except in special cases.

(5) Housing should be well constructed and frost proofing provided to such extent as justified by the estimates recommended in conclusion No. 1.

(6) The use of indirect heating to prevent ice accumulation in water tanks instead of direct heating by coils immersed in the water or steam injected into same should be considered.

(7) The use of frost proofing materials and the installation of sealed drainage in water column pits to prevent the inflow of cold air through the drains would, in many cases, benefit the operation of the water columns.

(8) The use of oil instead of coal for heating plant fuel should be considered in sections where coal cost is high or where continuity of attention cannot be conveniently provided for coal firing.

(9) Adequate drainage arrangements should be provided in all freezing latitudes.

Appendix F—Necessity for Providing Duplicate or Standby Pumping Units

Terminal and Important Main Line Stations.—The ratio of tank storage to the daily consumption at the larger terminals usually ranges from 20 per cent to 50 per cent, although in some instances storage capacities from 75 per cent to 100 per cent have been provided. With the lower ratios of tank storage to daily demand, any interruption in the water supply is very apt to seriously interfere with the prompt dispatching of trains from the terminals. At such terminals, all pumping equipment should be installed in duplicate, unless an auxiliary connection with a municipal or private water company's supply can be secured.

At smaller terminals, it may be found advisable to merely install standby equipment, as, for example, three similar units, any two of which are capable of furnishing the maximum daily requirements within twenty hours' pumping time.

At all important main line watering points, unless an auxiliary service can be made and water purchased in cases of emergency, either duplicate or standby equipment should be provided.

Less Important Main Line and Branch Line Stations.—Where the spacing of water stations is such that, should an emergency arise necessitating the removal of a water station from service and trains can be watered at adjacent plants without seriously interfering with normal train movements or requiring a reduction in tonnage handled, duplicate or standby units are unnecessary.

On the other hand, if the spacing between water stations is the maximum distance possible under ordinary operating conditions, it is advisable to install duplicate units or standby equipment.

Again, where the tank storage is sufficient to meet the demands over a period in excess of thirty-six hours, duplicate or standby units are unnecessary, since steam or gasoline driven equipment carried in divisional or district stores can be installed in cases of emergency without seriously interfering with normal train service, unless the supply is secured from a well.

Auxiliary Connections with Municipal or Private Water Companies.—Wherever a connection with a municipal or private water company's supply can be made and sufficient water of suitable quality can be purchased in emergency at reasonable rates, such connections may obviate the necessity of providing duplicate or standby equipment.

Deep Well Pumping Plants.—At terminals it will usually be found necessary to provide more than one well to secure the required amount of water and unless the wells are pumped by an air lift separate pumping equipment must be provided for each well. In the case of an air lift, it is advisable to install duplicate compressors and prime movers; however, where separate pumping equipment is provided for each well, it will usually be sufficient to provide equipment capable of furnishing a small excess of the daily peak requirement, since a failure of any single unit will not be of serious consequence. If it is possible to secure the total daily requirements of water from a single well at terminals or important watering points, it is advisable to provide another well with duplicate equipment, unless water can be secured from some other source in emergency.

Duplicate Motor Driven Plants.—Motor driven equipment should be installed in duplicate only when reliable electric power service is available or where interruption to the service caused by storms, transmission troubles, etc., will not seriously interfere with train movements. In all other cases, it is advisable to install standby equipment driven by some other source of power.

Relative Installation and Maintenance Costs.—The relative increase in first cost to provide duplicate pumping units will vary with the character and magnitude of the complete plant. As a general rule the increase in cost will average from 15 per cent to 25 per cent of the total cost of the plant, including all pipe lines, intake or suction wells and storage tanks, but excluding the cost of any water treating facilities which may be required. If a long discharge pipe line is necessary, the percentage increase in cost may be even less than that given above.

Conclusions

(1) Duplicate pumping units should be provided at all large terminals, unless a satisfactory connection with a municipal or private water company can be made and water purchased in cases of emergency.

(2) At smaller terminals and important main line watering points either duplicate or standby units should be installed, unless water can be purchased in cases of emergency.

(3) At less important main line stations and branch line stations the necessity, if any, for duplicate or standby equipment will be governed by local conditions.

(4) Where water is pumped from deep wells, the necessity of providing duplicate or standby units is dependent upon the number of wells required to furnish the daily consumption, as well as the nature of the equipment installed.

(5) The distinction between duplicate and standby units cannot be sharply drawn and the selection of type of protection to be provided will be controlled by local conditions and finances.

Appendix K—Economical Spacing of Water Stations

One of the most important factors limiting the length of a non-stop run is the question of water supply and fuel for the locomotives. In this matter, the problem of water supply is of especial importance as the use of this commodity will exceed that of coal between 600 and 900 per cent in weight.

Engine districts will vary in length depending upon local conditions but the average appears to lie between 100 and 150 miles. The ideal condition would appear to be in furnishing locomotives with sufficient water and fuel so that no stop for this material would be necessary between terminals.

A method taken by some railroads to reduce the delays from water stops has been the installation of track pans. However, the expensive maintenance of such equipment, including the mechanical as well as the track facilities, has held up consideration of such installation on many railroads.

During the past few years, experiments have been made with increasing the size of locomotive tanks. Whereas a capacity of 10,000 gal. was formerly considered exceptional, the use of six-wheel trucks has permitted additional loading so that there are now many engine tenders in service holding 16,000 gal. of water and on one railroad tanks with a capacity of 21,000 gal. are in use.

It was formerly considered good practice to locate water stations on an average spacing of from 15 to 20 miles, consistent with local conditions. On railroads where the large engine tanks have been placed in service water station requirements have changed radically and a possible spacing of between 30 and 60 miles is indicated as satisfactory. This fact is favorable from a water service standpoint to the extent that it permits concentration of facilities with greater opportunity for giving all water used better attention, and also allows better selections as to quality of supply.

Discussion

[The report was presented by the chairman, C. R. Knowles (I. C.), and the subject matter in Appendix A on revisions to the Manual and Appendix B on drinking water was adopted without discussion.]

W. J. Burton (M. P.): I note that Appendix C (pitting and corrosion) is written up in the first person. I think perhaps it would be better if that were written up as other reports and not in the first person.

Chairman Knowles: That has been recognized

by the committee and will be corrected for inclusion in the proceedings.

Maurice Coburn (Penna.): This is a pretty important subject and the committee has been working on it some time and there is a good deal of information available on the subject. We hope they will get busy and give us some real information before long.

Chairman Knowles: It is true that the information is badly needed on this subject and that the matter has been studied by various committees for the past 60 or 75 years. Up to the time this committee took up the subject there had been very little development and we expect to present further information in the future but during the past four years the committee working on the subject has been planning some line of action to correlate the information now in existence, but we hope to be able to present a little better report next year.

[Appendix C was accepted as a progress report, whereupon the chairman called upon Sub-committee Chairman C. H. Koyl (C. M. & St. P.) to present Appendix D on value of water treatment.]

Mr. Koyl: This year we have received a striking confirmation of the work we have been doing from a report of two years study of this question made by a committee of the New York Central Lines. This committee took as their datum the expense of fuel and boiler repairs per unit of locomotive energy expended in New England, where the water is practically perfect compared to the water in the Middle West. As the water increases in hardness from the East toward the West, so the expenses have increased and they have been very carefully tabulated in the last two years. Our original statement was that a pound of scale in a locomotive boiler costs 13 cents in fuel and boiler repairs. That report, originally made in 1914, was smiled at by a great many, but it has gradually been confirmed by the further tests which have been made and this year the New York Central is applying it to the three great divisions of the road and finds that it checks exceedingly well with the actual determinations which they have made of the fuel and boiler repairs, excepting only that our yardstick is always a little low.

Where our yardstick says that the expenses per year should be $3,000,000, the other committee finds the actual expenses were $3,300,000 or something like that, so that we present this at this time as a yardstick for measuring the damage done by impurities in boiler water and ask its acceptance by everyone because we consider it now established.

Mr. Coburn: When the committee was asked to differentiate between the different kinds of scale making material, we had in mind that they could go a little further than they have at this time. The report speaks about the insulating value of the different kinds of scale, but there are other matters in which they differ. Sulphate scale is much harder than carbonate scale, and if the sulphate scale is not present, the carbonate scale can be much more easily removed and sulphate scale when it is treated by the usual soda-ash method makes a foaming material. The soda-ash that is required for the material costs a good deal more than the lime. We made two analyses lately in a case where we wished to transfer from a normal station of about 20 grains of lime and soda-ash per gallon to another station where there was sodium carbonate, and the responsible officer when he saw the analyses said, "You have no advantage. One will make a scale and one will not." I hope the committee will continue and make further investigations.

Chairman Knowles: The committee secured valuable information from Mr. Coburn on the subject of the relative insulating value and destructive value of the two forms of scale, carbonates and sulphates. It is now working from that standpoint, but there are so many factors entering into the study of the different scales that it has not been possible to reach any conclusion. I assure Mr. Coburn we are still working on it.

Mr. Coburn: I appreciate thoroughly the valuable work that the committee is doing. It has been a great help.

[Without further discussion the subject matter in Appendix D was accepted as information, likewise Appendix E on heating, after which Appendix F on pumping equipment was presented and *the motion made to adopt the report for inclusion in the Manual.*]

C. C. Cook (B. & O.): Conclusion I says "unless a satisfactory connection can be made." Does that mean a satisfactory physical connection or satisfactory as to cost?

Chairman Knowles: It includes both a physical connection that is of sufficient size and at the proper rate.

Mr. Cook: It might be well to specify that, because frequently you can make a satisfactory physical connection, but the expense of purchasing city water is out of reason, and you wouldn't want to do it. You would want to put in the stand-by unit.

[The suggestion was adopted by the committee, whereupon the *motion to include the report in the Manual was put to a vote and carried.* Appendix K on spacing water stations was introduced by Subcommittee Chairman R. C. Bardwell (C. & O.)]

Mr. Bardwell: Considerable study has been given to the economics and cost of unnecessary train stops in the various railroads in the country, and an excellent report of it appears this year in one of the bulletins under the report of the Committee on Economics of Railway Operation. It is believed that one of the most prolific causes of unnecessary train stops lies in unnecessary water stations. On some railroads where the size of the locomotive tank has been increased, the number of water stations has actually been cut in half. We have endeavored to outline a few of the different problems which may be encountered, but in view of the study which is being given this subject by many railroads at present, it was felt that we could not draw any definite conclusions this year.

[The report was accepted without further discussion and the committee excused with the following remarks from the chair: "I think it should be noted that this committee has done a large amount of excellent and valuable work."]

Lombard, Mont., Where the Chicago, Milwaukee & St. Paul Crosses the Northern Pacific and the Missouri River

Report of Committee on Grade Crossings

Under its new name and the revised scope of its work the Committee on Grade Crossings concentrated its efforts during the year principally upon the important subjects relating to the financing of highway improvement and grade crossing elimination projects, reporting on methods of apportioning the cost of highway improvements, laws and regulations effecting the apportionment of federal aid, and the division of costs of grade separation work. Reports were also presented with regard to the character and extent of duplicate highway crossings, the economic aspects of crossing protection versus grade separation, and the relative merits of various forms of manual or power-operated crossing protection as against crossing watchmen. T. E. Rust has been chairman of the committee on Grade Crossings for 3 years and a member for 11 years.

T. E. Rust
Chairman

THE committee presented reports covering the following subjects: (1) Revision of the Manual (Appendix A). (2) Methods of apportioning the cost of highway improvements adjacent and parallel to railroad rights-of-way (Appendix B). (3) The value and safety of various forms of manual or power-operated grade crossing protection as against crossing watchman protection (Appendix C). (4) Collaborate with Committee on Signals and Interlocking, on various types of mechanical and power-operated grade crossing protection devices and their relative merits (Appendix C). (5) (a) Laws and regulations affecting the apportionment of federal aid; (b) the proper form and character of division of costs of separation of grades as between the railway, state, county, municipal or other corporation (Appendix D). The committee reported progress on the subject of, (a) the character and extent of unnecessary or duplicated highway crossings over railways with methods for their combination and consequent elimination, and (b), the economic aspect of grade crossing protection in lieu of grade separation.

In reporting on subject 4, the committee stated its inability to decide upon the merits of each kind of protection at this time.

It recommended that the reports on the above subjects be received as information.

Committee: T. E. Rust (W. C. F. & N.), chairman; A. B. Griggs (A. T. & S. F.), vice-chairman; O. C. Badger (Portland Cement Association), F. D. Batchellor (B. & O.), B. F. Beckman (Ft. S. & W.), Bernard Blum (N. P.), J. F. Burns (L. & N.), R. E. Chamberlain (B. & O.), H. S. Clarke (D. & H.), W. E. Colladay (I. C.), L. B. Curtiss (B. & O. C. T.), A. F. Dorley (M. P.), G. N. Edmondson (N. Y. C.), F. M. Graham (Penna.), C. E. Herth (B. & O.), W. O. Houston (M. C.), R. L. Huntley (U. P.), Maro Johnson (I. C.), F. G. Jonah (St.-L.S. F.), R. B. Kittredge (State University of Iowa), A. E. Korsell (C. R. I. & P.), A. C. Mackenzie (C. P.), H. G. Morgan (I. C.), G. P. Palmer (B. & O.), J. A. Peabody (C. & N. W.), Frank Ringer (M.-K.-T.), H. M. Shepard (Erie), T. S. Stevens (A. T. & S. F.), F. J. Stimson (Penna.), M. D. Thompson (I. C.), W. J. Towne (C. & N. W.), A. H. Utter (C. B. & Q.), I. D. Waterman (N. Y., N. H., & H.).

Appendix A—Revision of the Manual

Owing to the revised scope of the work assigned to this committee, all matter now in the Manual relating to signs, fences and crossings, with the exception of highway crossing signs, and specifications for highway grade crossings, has been transferred to Committee on Roadway. The committee is giving consideration to a possible revision of the highway crossing signs adopted last March, and may submit a report on this subject later.

Appendix B—Methods of Apportioning the Cost of Highway Improvements Adjacent and Parallel to Railroad Rights-of-Way

Within the last few years the trend has been to finance an increasingly large part of the cost of highway improvements by gasoline taxes and license fees rather than by property taxes. In order to obtain definite information in this regard a questionnaire was addressed to the attorney-generals of the various states and also to the general solicitors of the larger railroads operating in the various states.

From the information received it is noted that there are only four states, namely Illinois, Massachusetts, New Jersey and New York, which have no gasoline tax, the remainder of the states financing a considerable portion of their road improvements by means of a gasoline tax and motor vehicle fee.

The committee presented a statement showing the amount of revenue derived from gasoline taxes for the first six months of 1926. On the basis of this statement it was pointed out that American motor vehicle owners will pay approximately $170,000,000 in gasoline taxes this year. The total gasoline tax for the first six months of this year was divided as follows: 65 per cent to the state highway departments, 23 per cent for county and local roads, 7 per cent for state and county road bonds, and 5 per cent for miscellaneous.

In all states imposing a gasoline tax the rate varied from 1 to 5 cents a gallon with an average of 2.39 cents.

The committee expressed its belief that the fact that a highway is located adjacent and parallel to a railroad right-of-way should have no bearing on the method of apportioning the cost of highway improvements. Recognizing that where property is in fact benefitted by highway improvements such property should bear a share of the cost, the committee still felt that the greater portion of the cost of highway construction and maintenance should be paid for by the users of the highways in the form of motor vehicle license fees and gasoline taxes.

Appendix C—Manual or Power-Operated Grade Crossing Protection vs. Watchman

As a basis for studying the above subjects a request was made on the larger railroads for a copy of their annual reports made to the Interstate Commerce Commission covering grade crossings.

From the information obtained we find that the kinds of protection generally used are as follows: (1) Gates with or without other protection, operated 24 hours per day; (2) gates with or without other protection, operated less than 24 hours per day; (3) watchmen alone or with protection other than gates on duty 24 hours per day; (4) watchmen alone or with protection other than gates on duty less than 24 hours per day;(5) both audible and visible protection without either protection; (6) audible signals only; (7) visible signals only (8) special fixed signs, or barriers, in addition to standard fixed signs; (9) standard fixed signs only.

Gates.—Of the total number of crossings reported 2.8 per cent were projected by gates, 2877 being in service 24 hours and 2399 in service less than 24 hours. There were 62 less crossings protected by gates on December 31, 1925, than there was on January 1. This type of protection is good under certain conditions where street traffic is not too heavy and when operated for 24 hours, but it also has its disadvantages.

Watchmen.—Three and four-tenths per cent of the crossings reported are protected by crossing watchmen, or a total of 6422 crossings; 990 of these are protected during the 24 hours and 5380 less than 24 hours per day. There were 139 less crossings protected by watchmen on December 31, 1925, than on January 1, 1925, showing that this type of protection is decreasing. With the advent of the automobile traffic, conditions have changed and a crossing watchman must be alert, physically and mentally. Where considerable switching is done crossing watchmen probably afford the best protection, but on the average crossing we do not believe this is the best type of protection. Where crossing watchmen are used they should display a "Stop" disc by day and a red hooded lantern by night, when it is unsafe to cross. Crossing watchmen should have police power of control over traffic.

Signals.—Five and four-tenths per cent of the crossings reported are protected by signals, or a total of 10,238 crossing, 4367 of the crossings being protected by both audible and visible signals, 4691 by audible signals only, and 1272 by visible signals only. During 1925 there was an increase of 391 crossings protected by both audible and visible signals, a decrease of 303 crossings protected by audible signals only and an increase of 246 crossings protected by visible signals only.

We believe that where practicable, the automatic visible signal is the most efficient protection in use for the following reasons: (1) It is automatic; (2) the failure of the engineman to blow the whistle or ring the bell has no effect on the signal; (3) weather conditions have no material effect on it; (4) signals are easily seen and there is no mistaking the signal given.

Special Fixed Signs or Barriers.—We are assuming that this applies to advance signs placed on side of the roadway calling attention to the approach to railroad crossings. We believe that the special fixed sign in advance of the standard crossing sign is an excellent thing, as it gives the user of the highway advance notice that he is approaching a railroad crossing.

Standard Fixed Crossing Signs.—By far the greater number of crossings are protected in this manner only, being 77.9 per cent or 147,245 crossings as of December 31, 1925. It would seem that the crossing protected only by standard fixed signs, being so universal, is the one which should be given serious consideration.

The Railroads Should See: (1) That all obstructions on the right-of-way are removed so as to give as clear a view as possible of the tracks; (2) that the crossings and grades are kept in the best possible condition; (3) the enginemen blow their whistle and ring engine bell on approaching crossings and continue until crossing is reached; (4) that engine be equipped with whistle of sufficient volume to be heard at the crossing, and (5) that cars, so far as possible, are not left standing on tracks adjacent to crossing where they will obstruct the view.

The Public Should: Approach crossings cautiously and not attempt to cross until they have satisfied themselves that no trains are approaching. They must realize that trains must travel on the rails and that they must maintain their speed in order to make schedule, required by the public.

The Public Authorities Should See: (1) That all obstructions off of the right-of-way are removed so as to give as clear a view as possible of the tracks, and (2) that grades approaching crossings are kept in good condition.

Appendix D—Study and Report on (a) Laws and Regulations Affecting the Apportionment of Federal Aid; (b) the Proper Form and Character of Division of Costs of Separation of Grades as Between the Railway, State, County, Municipal or Other Corporation

In handling the first part of this assignment (a), the committee included within its report a list of the congressional acts under which federal aid is authorized. In order to inform itself as to the legal status of the federal aid acts, the committee addressed an inquiry to the legal departments of various railroads. The matter was referred to the Western Conference of Railway Counsel and its reply indicates; (1) there is no specific provision in the federal statutes requiring the states to apportion any part of the state quota of funds secured from federal aid to grade separation projects; (2) there is no provision in any of the federal aid acts which railway companies can use to compel, through legal proceedings, the state to apportion a part of the federal aid allotment to a particular grade separation project; (3) there is no provision in the federal aid acts that would prohibit a state from allocating a part of its federal aid allotment to a particular grade separation project, and in fact such allocation is made in many instances.

The committee also reported that during the year a recanvass was made of the public service commissions of the states to ascertain the provisions of the laws of the several states and Canada as they apply to public crossings and, more particularly, to their application to the elimination of grade crossings.

The replies indicated that the changes in the statutes, as they appeared in the 1924 proceedings, did not warrant a restatement of them.

In handling the second part of these subjects (b) the committee stated that it appears that the present tendency of the state authorities is to assess 50 per cent of the expense of grade separation against the railroads. It was the belief of the committee that this ratio is too high, and that the total cost to the railroads is too great for their capacity to pay, and, furthermore,

that an assessment of a smaller ratio against the railroads and a corresponding increase in the proportion assumed by the public is reasonable and fair to all parties and interests.

The committee concluded that the question of federal aid with reference to grade separation is at present in such shape that the state authorities can so handle the matter as to entirely eliminate the railroads from any participation in the benefits of its use and that this situation can be remedied only by legislation or possibly by changes in the regulations promulgated by the federal authorities governing the matter.

Supplemental Report On Grade Crossings

Supplement to Appendix A—Revision of the Manual

A year ago this Association adopted the design of a highway crossing sign which was submitted by the committee but instructed it to consider changing the wording of the supplemental sign shown on the design by dotted lines from "Stop. State Law" to "Two Tracks," it being the idea that it was important to call the attention of the members to the desirability of using a supplemental sign reading TWO TRACKS, THREE TRACKS, etc., as appropriate, at all crossings of more than one track.

As a part of the widespread effort to reduce the alarming increase in the number of accidents at grade crossings, the highway crossing sign has been receiving considerable attention from various sources. It is not unusual nowadays for an automobile driver to pass through parts of several states in the course of a single day's journey and it is obviously in the interest of safety to have the sign that indicates a railroad crossing the same in every state. Several railroads or groups of railroads have attempted to secure some degree of uniformity in their own territory by negotiation with the states involved and have met with some success, but strangely enough in no instance, so far as the committee knows, have they asked the adoption of the A. R. E. A. sign.

As a part of its report of last year the committee suggested that the Association urge the railroads and the appropriate public bodies in the various states to adopt the A. R. E. A. sign, subordinating their individual preferences to greater uniformity and greater safety. The action of the convention in instructing the committee to reconsider the wording of the supplemental sign, the discovery that the striping of the post conflicted with some conclusions of the American Railway Association and the vigorous criticism of the general design by one of the members made it impossible to go ahead with any such plans until the committee had again studied the design and submitted its conclusions for approval. It is hoped that the Association will accept the report with such amendments, if any, as seem desirable rather than refer the matter back for further consideration.

The committee considered the suggested change in the wording of the supplemental sign but decided against recommending it.

In the design adopted last March the dimensions of 10 in. for width of blade and 6½ in. for height of letters are shown. Several states have adopted rules requiring letters on the crossbuck to be not less than 9 in. high. In order to permit variation in width of board or height of letter to conform to local laws, the committee believed it would be well to omit these two definite dimensions.

Conclusions

1. That the striping of the post as shown on the design of highway crossing sign adopted March, 1926, should be omitted.

2. That the dimensions of 10 in. for width of blades and 6½ in. for height of letters as shown on this design should be omitted.

3. That the reading of the "Note" on such design should be changed by adding "The plan shows the sign mounted on a wood post. When a post of steel or concrete is used the dimensions of the post should be suitable to the material employed."

Discussion

[Chairman T. E. Rust (W., C. F. & N.) introduced the report.]

Chairman Rust: This year for the first time, the committee has been relieved of the subject of fences and the only signs over which it continues to hold jurisdiction are the highway crossing and approach signs. The work which has been assigned to the committee this year gives opportunity for much interesting and valuable work.

I will ask Mr. Johnson, chairman of the sub-committee, to present the report on the revision of the Manual.

Maro Johnson (I. C.): The committee has given consideration to the possible revision of the highway crossing signs adopted last year. The revised conclusions are:

"1. That the striping of the post as shown on the design of highway crossing sign adopted March, 1926, should be omitted.

"2. That the dimensions of 10 in. for width of blades and 6½ in. for height of letters as shown on this design should be omitted.

"3. That the reading of the 'Note' on such design should be changed by adding 'The plan shows the sign mounted on a wood post. When a post of steel or concrete is used the dimensions of the post should be suitable to the material employed.' "

I move the adoption of these conclusions.

C. W. Baldridge (A. T. & S. F.): The motion last year provided for eliminating the word "Stop." I made the motion last year and the motion was that the committee be asked to consider adding information showing the number of tracks to be crossed. The motion did not provide for eliminating anything from the sign as presented by the committee.

Chairman Rust: That sign is shown in dotted lines merely to say to those who use this sign as a guide, "If you are going to put a sign on the post put it here." It isn't intended to say that the sign shall be of that shape or that it shall contain these words. It is simply an indication of where a supplemental sign is to be used. Most of the committee thinks that when any signs can be avoided on a post it is a good thing not to have them on there, but in many places local laws require a sign on the post. The committee, in showing only the one sign and voting to retain the wording that was given in the design of last year, rather had in mind that this design would be distributed amongst the public service bodies of one kind or another and maybe it thought by doing so it could inject a little propaganda into the sign.

R. H. Ford (C. R. I. & P.): I am inclined to follow the thought of the committee, which I assume is more conservative than anything else. The sign question is getting to be serious, especially in the protection of railway grade crossings. There are about 48 states and as many legislatures and as many highway commissions,

also the federal department of highways, and the Hoover committee as well, all of which have some form of sign and some form of lettering to suggest. Doubtless the committee is going to keep in touch with the federal department of highways and with these various states to see if we can't get something that is universal on the question of the approach sign.

Chairman Rust: We all realize the desirability of not adopting any standard until it has received careful and usually several years' consideration, but this highway crossing sign is a somewhat different situation. The longer we postpone action looking to securing universal adoption of this sign, the worse the disorder is going to be in highway crossing signs. I know of one railroad commission that is waiting for the action of the Association to adopt a highway crossing sign. If we postpone the matter another year, I think several other states will adopt a design for the highway crossing sign different from what we now propose.

The committee is not set on some of the details of this sign, and if this convention wants to change some of these details, it will meet the pleasure of the committee, but what we do think ought to be done is get the thing settled.

[*The motion to adopt the report of the sub-committee was put to a vote and carried,* following which Appendix B was accepted and Appendix C then was presented by F. D. Batchellor (B. & O.), chairman of the sub-committee, who outlined the report.]

W. C. Cushing (Penna.): If there is any virtue in the subject of standardization and simplification of practice it reaches a high degree of value in the case of highway crossing protection, and it is badly needed there, because at the present time no complete plan for such protection has been issued or placed upon a well defined basis. Nevertheless, through the work of the American Railway Engineering Association and the American Railway Association, some of the methods of protection have been pretty well defined and standardized, such as the method of painting crossing gates; approach sign; crossing gate lamp; hand sign or flag for watchmen, and general type of cross-buck sign.

Something else is needed with even greater urgency, as touched upon in this Appendix, and that is a general plan for highway crossing protection which can be used universally by the operating officers and public authorities for deciding upon the protection required for a particular crossing based upon the degree of hazard, with modifications according to state statutes, township and municipal ordinances, and public service commission regulations. By persistent and systematic work on the part of this association and its committees, these modifications by public authorities should be made fewer and fewer until a considerable degree of uniformity can be attained.

A plan of this kind will enable the division officers of a railroad to present a plan for protecting any one crossing to the public authorities in charge in accordance with a definitely outlined idea, which ought to carry considerable weight and relieve him of some of his trouble in carrying on negotiations.

The committee has quoted a considerable amount of interesting information on this subject in its report. Particular attention is called to the fact as expressed in Table B that the greatest number of crossings at track level over the railroad are greatest in number on the Pennsylvania with 12,326.

It seems to me important to call attention to the attempt of the Pennsylvania to carry out the idea expressed in this discussion. The plan outlined is divided into two parts:

(1) General principles for protection which lay down rules for crossing protection under three classes, and lays stress upon automatic protection as the best plan, ultimately replacing crossing gates and watchmen.

(2) Operating regulations stating all the information necessary for the division officers to enable them to protect the crossing according to its class, and be familiar with the orders of public authorities in the several states.

Mr. Baldridge: This report gives the number of crossing watchmen which have been dispensed with during the past year. I should like to ask how many of those crossing watchmen were displaced by the elimination of grade crossings and how many were dispensed with by the adoption of other forms of crossing protection.

Mr. Batchellor: We were unable to get any information of that kind from most of the railroads.

[Without further discussion the report in Appendix C was accepted as information, following which Appendix D on State Laws and Regulations was outlined by A. B. Griggs (A. T. & S. F.), the sub-committee chairman.]

Mr. Griggs: Since the publication of the bulletin the committee wishes to revise the third paragraph of the conclusions as follows: "It is a recommendation of the committee that proceedings should be undertaken along the channels and through the personnel available to the railroads acting together as best adapted to secure such changes in existing regulations or such further legislation, if any, that may be necessary to secure such application of Federal Aid funds to grade separation work as appears to be equitable to the railroads as set out in this report."

J. P. Hanley (I. C.): I gather that there is nothing in any of the acts either for or against the apportioning of certain funds to the railroads for separating grade crossings. Has that ever been brought up before the courts, or have any of the courts made a decision on it. It appears that a separation of grade crossings would be of mutual benefit to the highway commissions as well as to the railroads; it would seem that some division of the expense should be made.

Mr. Griggs: The funds that are discussed in this report are only the Federal Aid funds. We do not know of any decision by either state or federal courts with respect to the questions raised in our report. However, the consensus of the legal departments of the railways is as stated, that the railroads cannot force the states to handle their funds other than as they see fit.

Mr. Ford: I think the situation can best be expressed by the fact that our existing legislation generally is of the horse-drawn vehicle stage, and as such when it goes before the courts, as it has in a great many cases, the decisions are usually unfavorable to the railroads. A prominent federal officer who has much to do with the direction of the question of the nationalization of grade crossing elimination recently stated that what is needed, and very badly needed, is a revision of our statutes in the various states so that this question can be more equitably met by the railroads and the states themselves.

I would like also to say that the review in the report on the opinions of lawyers is open to considerable doubt. I have reason to believe that the subject is being studied anew by the same committee of lawyers who made that report. The lawyers are no different, I guess, than some of the engineers; they may be wrong sometimes.

L. J. Riegler (Penna.): In Ohio the state authorities have on several occasions taken the position that

the fundamental purpose of Federal Aid is the improvement and establishment of post roads, and for that reason Federal Aid is applicable only to places where there is a low density of population, and therefore it does not apply to places where there is a greater density as in the municipalities and so forth. I am wondering if the committee have found any such interpretation in the other states.

Mr. Griggs: We have not found that to be the case. I think it might be said, however, that a little greater per cent of the total cost of a Federal Aid project is allocated to some of our Western states, like Arizona and Utah and Nevada than is given to the states of denser population.

[There being no further discussion the report was accepted as information and the committee excused.]

Report on Economics of Railway Labor

The Committee on Economics of Railway Labor again devoted its efforts to the study of railway labor problems and labor saving devices and it submitted two highly important reports for inclusion in the Manual, one on the extent to which it is practical to stabilize employment in the maintenance of way department and the other on methods of maintaining motor cars, in which was included rules for the care of cars. The first of these reports contained a list of maintenance of way tasks that can be done economically in the winter, with the reasons for including each item. Other reports included a detailed review of ballast cleaning methods and equipment. C. C. Cook has been chairman of this committee for four years and a member of the committee for the last seven years.

C. C. Cook
Chairman

THE committee presented reports covering the following subjects: (1) Revision of Manual (Appendix A). (2) The extent to which it is practicable to stabilize employment in the maintenance of way department in the interest of efficiency, and the necessary measures to accomplish it (Appendix B). (3) Economy in the use of labor-saving devices (Appendix C). (4) Methods of maintaining motor cars (Appendix D); (a) Rules for car and operation of motor cars; (b) Standardization of motor car parts. (5) Equating track values for labor distribution.

It Recommended: (1) That the change in the Manual in Appendix A be approved and the revised version substituted for the present recommendation in the Manual. (2) That the conclusions in Appendix B, relating to stabilization of employment in the maintenance of way department, be approved for publication in the Manual. (3) That the report in Appendix C, relating to economy in the use of labor-saving devices, be accepted as a progress report. (4) That the rules in Appendix D, relating to methods of maintaining motor cars, be approved for publication in the Manual; (a) rules for the operation of motor hand, velocipede, and push car, and (b) rules for the care of motor cars. (5) No action was desired on the subject of equating track values for labor distribution.

Committee: C. C. Cook (B. & O.), chairman; A. N. Reece (K. C. S.), vice-chairman; Lem Adams (U. P.), Hadley Baldwin (C. C. C. & St. L.), A. S. Butterworth (M. S. B. & P.), H. A. Cassil (P. M.), H. M. Church (C. & O.), J. F. Donovan (L. V.), J. A. Heaman (G. T. W.), D. E. Helvern (A. T. & S. F.), Elmer T. Howson (Ry. Age), F. G. Jonah (St. L.-S. F.), C. E. Johnston (K. C. S.), J. D. Keiley (C. & O.), J. W. Kern, Jr. (I. C.), J. B. Mabile (C. R. I. & P.), W. A. Murray (N. Y. C.), G. M. O'Rourke (I. C.), J. C. Patterson (Erie), H. A. Roberts (O.-W. Ry. & N.), R. L. Schmid (N. C. & St. L.), F. S. Schwinn (I. G. N.), J. M. Sills (St. L.-S. W.), H. M. Stout (N. P.), F. M. Thompson (M.-K.-T.), Cale Wamsley (M. P.), B. A. Wood (M. & O.).

Appendix A—Revision of Manual

Change subject matter in Supplement to Manual, 1921, Bulletin 250, page 56, under the heading, "Training and educating employees (other than engineers) in the Maintenance of Way Department, looking to greater economy and efficiency as well as promotion," to read (Paragraph 4): "Employees should be encouraged to seek further education from outside sources on general principles of railway operation, such as through correspondence, night schools, periodicals on railway subjects and membership in railway clubs and associations."

Appendix B—Stabilization of Employment in the Maintenance of Way Department

Equalization of Expenses

From its report of a year ago the committee presented the following conclusion: The equalization of expenses permits work to be done at the most economical time, seasonal and traffic conditions considered. It also prevents the distortion of operating ratios, while by its application more uniform forces may be employed in maintenance of way work, thereby tending toward stabilization of forces.

The Determination of the Extent to Which the Maintenance of Uniform Forces is Justified

An analysis of reports from individual sections on nine railroads representing practically every part of the United States shows that for an average yearly employment of 48 men on ten sections for a three-year period, 423 men were actually in service, or a ratio of nine men to one actually required. An average of 54 men were employed for the eight months, March to October, inclusive, whereas 356 men were hired to supply this number, or a ratio of seven to one. For the other four months, namely, November, December,

January and February, an average of 37 men was required with 196 men actually employed for the service, giving a ratio of 5.5 to 1.

It is our opinion that the excessive turnover would be greatly reduced if a comparatively uniform force were employed throughout the year. As proof of this contention we note that in almost every instance in examinations of the payrolls which we have studied, men comprising the minimum force remained in service throughout the period.

As a result of its study the committee submitted a list of the items of work that it recommended can be performed economically during the winter:

Accounts Affected by Work That Can Be Economically Done in Winter Months

Account No.	Description	Remarks
202	Roadway maintenance	Bank protection (particularly riprap)
206	Tunnels and subways	Repairs and heavy replacements
208	Bridges, trestles and culverts	Renewing deck
214	Rails	Relaying
216	Other track material	Renewals and repairs
220	Track laying and surfacing	Applying rails and O. T. M.
221	Right-of-way fences	Repairs
227	Station and office buildings	Inside repairs
229	Roadway buildings	Inside repairs
231	Water stations	Renewals and repairs, inside work on pipes, pumps, engines, etc.
233	Fuel stations	Inside repairs
235	Shops and engine houses	Inside repairs
237	Grain elevators	Inside repairs
239	Storage warehouses	Inside repairs
247	Telegraph and telephone lines	Clearing brush and branches from wires
253	Power plant buildings	Inside repairs
255	Power sub-station buildings	Inside repairs
265	Miscellaneous structures	Inside repairs
269	Roadway machines	Repairs—general overhauling
272	Removing snow, ice and sand	Snow and ice (winter work)
326	Work equipment	Repairs to camp cars and roadway machines

The conclusion of the committee was as follows:

In consideration of the ultimate economy of building a strong personnel of labor forces and the immediate economy of holding experienced men in maintenance of way service, as much work as is economically possible should be done in the winter, thus stabilizing forces.

The Effect of Stabilization of Employment on Uniform Purchases of Materials and on Their Costs

From its report of a year ago the committee drew the following conclusions: Minimum cost is secured through uniform production; reductions in manufacturing costs are directly reflected in prices charged the railroads; stabilization of forces with the resulting increase in the uniformity of use of materials will lead to savings in the cost of materials over and above the savings effected directly through the increased efficiency of the forces.

Appendix C—Economy of Labor-Saving Devices

Ballast Cars, Unloading and Distributing

A new type of this car has been designed with a narrow floor with recessed slopes along the side that meets the lower edge of the swinging side door. It has been found that with this design the larger rocks and boulders drop down and out very easily and do not get jammed as on the old type car. This reduces side thrust strain and damage. It cuts repair bills and reduces long loss of time on the repair track. Cars of this type may be used for revenue service.

The increased speed and ease of handling ballast with specially designed ballast cars is an important factor in the final cost. From time studies shown in A. R. E. A. Proceedings of 1922 the cost of unloading ballast for one mile of double track varied greatly with the type of ballast car used. For special ballast cars, 37 payroll hours; for 100,000-lb. hoppers, 63 payroll hours; and for 100,000-lb. gondolas, 335 payroll hours were used.

Cleaning Ballast—With the price of rock ballast from $0.80 to $1.00 per ton, any efficient method of cleaning ballast will always be an important item in labor-saving discussions. There are four major operations in cleaning ballast, skeletonizing the track to the base of ties, removing the dirt from the ballast, replacing the ballast, and disposing of the waste.

Several machines for removing the ballast from the cribs have been put in use, but the most notable of these is a power skeletonizer. It is a self-propelled machine weighing 9,000 lb. with two pairs of wheels set transversely to the track for setting off. The machine has four hoes, two of which work inside the rails and two outside. The outside hoes start first and as soon as they have cleared a space the operator starts the inside hoes which gather the material at a point where the outside hoes can reach it.

Another method of cleaning ballast is with the locomotive crane, with which there are several specially designed ballast digging buckets available for ballast cleaning operations. The cost on an Eastern railroad for cleaning rock ballast per mile with such buckets and screens on cars varied from $656 to $1,617, the difference in cost being due to train delays. This cost includes all repairs, lubricants and coal. To clean the same amount by hand cost $1,287 per mile when labor was paid 16c per hour, or $3,219 at current rates. These figures would indicate a saving of approximately 60 to 70 per cent.

A new machine now being tried by an Eastern road for cleaning ballast between the ends of ties on multiple track is said to clean to a depth of 16 in. with tracks at 13-ft. centers at a rate of 1,200 lin. ft. per 8-hour day. The machine is guided by angle-irons laid parallel to the rails and is moved by cogs running in notches in these angle-irons. The ballast is loosened by two eccentric inclined discs and carried back to the screen on an endless belt. The dirt passes through the screen onto another endless belt and into boxes which must be carried out and dumped as they become filled. The clean ballast goes directly back to the track. This machine under ordinary conditions cleaned ballast at a cost of 6c per liner foot of center ditch.

The vacuum ballast cleaner now in use on a large eastern railroad is described fully on page 102, A. R. E. A. Proceedings of 1924.

Another machine, though still in the experimental stage, is a steam-driven track sweeper. The sweeper consists of a steam engine mounted on a flat car with a suitable cab at one end, a rotary steel broom revolving at a speed of about 100 R.P.M. and two belt-conveyors, one of which catches the sweepings from the broom and elevates them to a second conveyor which carries them into a gondola placed immediately ahead of the sweeper. Up to the present time this sweeper is superior to any other mechanical device for doing the same character of work.

Tie Tamping—The cost each year of surfacing out-of-face track has been one of the heavy drains on the annual budget. As shown on page 1048, Vol. 27, Proceedings of 1926, out of 20 railroads replying to questionnaire, 11 reported an average saving of 37 per cent per mile or 12 per cent of the initial cost of the machine by the use of mechanical tampers and the other nine reported no tabulated saving but a much better and more uniformly tamped track.

Replies received during the current year indicate a saving per foot of track of $.041 or 33 per cent of the actual cost and a much better tamped track, by the use of mechanical tampers.

A new power ballaster, put on the market, is making a bid for recognition as a labor-saver. It consists of a self-propelled motor car carrying a five-piece hammer weighing 2,000 lb. that delivers a blow the full length of the tie and is said to tamp the ballast uniformly between and beneath the ties and leaving very little settlement even after high raise. Tests were made with one of these machines on a large western railroad during the summer of 1925, and with such satisfactory results that three machines were purchased for 1926 trials.

A patented track raiser and shifter that consists of a steel framed car on which is mounted a 40 hp. gas motor for prepelling the machine and operating a powerful worm-driven spud which supplies the lifting action has been placed on the market. It is easily operated by one man and exerts a lifting force of 50,000 lb.

Dressing Ballast—One foreman and nine men make a well-balanced gang for this work, two men leveling berm, two men building stone line, two men forking ballast from between the rails, two men dressing shoulders and one man dressing the center ditch. Proper distribution of ballast by work train is essential to economical results. It has been found economical on single-track work in cinder or gravel ballast to use a machine such as a spreader to dress the ballast.

Track Liners—The results of a test carried on under the supervision of the engineering corps of a large Eastern railroad show a marked saving with track liners over the old method and correspondingly smooth track. Replies received from 14 railroads during the current year indicate a saving from 20 per cent to 66 per cent with an average of 49.3 per cent. The average number of liners to a small gang was given as three and to a large gang as five.

Conclusions

(1) The economy in the use of special equipment ballast cars, ballast cleaning devices, ballast shoulder shaping devices, tie tampers and track liners has been demonstrated and their use is recommended.

(2) The committee recommended that investigations along these lines be continued, a small number of labor-saving devices being selected for detailed study each year.

Appendix D—Methods of Maintaining Motor Cars

(a) Rules for Care and Operation of Motor Cars

(b) Standardization of Motor Car Parts

Rules for Care and Operation of Motor Cars

The committee re-drafted and revised the rules in the Manual for the operation of motor, hand, velocipede and push cars, and also drafted 12 new rules for the care of motor cars.

(Note—For convenience, both the numbers as given in the 1921 Manual and in Bulletin 279 of September, 1925, are written before each rule).

New rule. Cars must not be operated when known to be in unsafe condition.

79-261. Amended rule to read, "No one except a responsible employee who has been qualified and authorized will be allowed to operate motor, hand or velocipede cars upon the main track."

82-264. Reword the last sentence to read as follows: "The use of seats not securely affixed to cars is prohibited."

83-265. Revise rule to read as follows: "Tools and material must be properly placed on cars to prevent their falling off. Track jacks must not be carried on front end of car."

84-266. Eliminate.

85-267. Eliminate the last sentence of old rule reading: "No open telegraph office should be passed without stopping and ascertaining the location of all trains." Add the following sentence: "Cars must be operated with the expectation of finding main track in use and care exercised to avoid striking other cars."

86-268. Revise to read as follows: "Where practicable, cars must be run on outside main tracks in the direction of traffic or on sidings. A sharp lookout must be maintained in both directions, and where the vision is obscured or impaired flagging rules must be observed."

87-269. Revise first sentence to read as follows: "When approaching workmen on or near track, or when approaching road crossings at grade, the car must be under complete control or stopped, and the employee in charge must know that the workmen or highway traveler will not be endangered before proceeding."

91-273. Rewrite rule to read as follows: "Cars must not be attached to engines or trains and they must not be run closer than 500 ft. behind moving trains nor stopped within 200 ft. of standing trains."

92-274. Rewrite first sentence to read as follows: "Unless coupled, space between two or three cars when running must not be less than 500 ft." (Remainder of the rule to stand as at present.)

100-282. Rewrite to read as follows: "When necessary to ship motor cars on trains, gasoline tanks and carburetors must be drained."

Rules for the Care of Motor Cars

(1) An employee, in order to properly qualify himself to operate a motor car, must thoroughly understand the complete cycle of operation of the engine, study the printed booklet of instructions furnished by the maker, and acquaint himself with the gasoline circuit, the electric equipment and circuit, the methods of lubrication, and the proper methods of starting and stopping the engine and car.

(2) Motor cars must be inspected carefully before starting to detect loose or broken parts and see that the wheels are in proper alinement. When running, attention must be given to any unusual noise about the engine or car, and the car must be stopped and adjusted before proceeding. In making long runs the car must be stopped periodically and examined for overheated parts or bearings and to insure proper lubrication.

(3) Motor cars must be thoroughly cleaned and all bolts and nuts tightened at least once each week. A thorough inspection of all parts must be made when car is overhauled or cleaned.

(4) Engine must not be raced or left running when the car is standing.

(5) All wearing parts and bearings of engine and car must be kept properly lubricated. When lubricated gasoline is used, it must be properly proportioned and mixed before placing in the fuel tank.

(6) In case of motors having water cooling systems, water tanks and radiators or jackets must be kept properly filled and during freezing temperatures they must be protected against freezing or the water drained when not in use.

(7) More than the required number of dry cell batteries must not be used. Spark coil vibrator must be kept clean and properly adjusted. Spark plugs must be kept clean and free from carbon. Timers must be kept clean, well oiled and in proper adjustment. Wiring must be properly insulated and connections kept tight.

(8) To secure the lowest maintenance and highest efficiency in the engine, the carburetor must be adjusted by a competent man and must not be tampered with. Gasoline must be kept free from stoppage and leaks immediately repaired.

(9) In case of belt driven cars, tension on belts must not be excessive. In the case of friction disc drive, the disc must be kept clean and dry and free from oil.

(10) Extreme care must be exercised in the handling of gasoline and gasoline should preferably be stored in tanks removed from the motor car house. Gasoline must be strained before placing in fuel tank. Fuel tank, oil cans and funnels must be kept clean.

(11) The employee in charge of motor car will be fur-

nished with proper complement of required tools and will be responsible for their use and care.

(12) Care must be exercised in placing motor car on or off the track and in loading or unloading tools, to avoid disturbing the adjustment of engine or damage to engine or car.

Standardization of Motor Car Parts

This subject was not assigned to an independent sub-committee, but included in the correlated subjects on Rules for the Care and Operation of Motor Cars.

In order to properly develop the standardization of detail parts, we must first know what a standard motor car is for section and other common uses on the railways. The committee is working with the engineer representatives of the motor car manufacturers in the development of the standardization of motor car parts, and anticipates results from its efforts through that channel.

The conclusions of the committee were as follows:

The adoption and printing in the Manual of the revision of the Rules for the operation of motor, hand, velocipede and push cars, and also the twelve new rules submitted for the care of motor cars. It reported progress on the subject, Standardization of Motor Car Parts.

Discussion

[C. C. Cook (B. & O.), the chairman of the committee introduced the report and submitted the matter on revision of the Manual in Appendix A. *His motion that it be approved was carried.* He then introduced Lem Adams, (U. P.), the chairman of the sub-committee on the stabilization of employment who presented the matter in Appendix B.]

C. W. Baldridge (A., T. & S. F.): The committee has analyzed the turnover of labor in the summer months as against the turnover of labor in the winter months and shows that the turnover of labor in the summer months is 7 to 1 and that the turnover of labor in the winter months is 5½ to 1. I can't enthuse very much over the idea that you are getting any benefit out of the winter work with only that slightly better showing for winter work over summer work.

Mr. Adams: We offer that information simply to show some of the wide variances that we have to experience. However, if any of you are at all skeptical about what your labor turnovers are and would like to get some first-hand information, I suggest you analyze some of your section labor payrolls.

Robert H. Ford (C., R. I. & P.): I think we all appreciate the difficulty that the committee would have in undertaking to analyze figures of this character. I am wondering, however, if the committee has taken some specific cases, as for example a railroad where practically all of the maintenance expenditures were equalized over the year and compared it with a railroad that had little or no equalization of expenses. It might develop some interesting information.

Mr. Adams: The point just raised by Mr. Ford is a very good one. We did make such an analysis on a few railroads that have comparative stabilization and the results shown were that their turnover was less than 3½ to 1, which I think is another very strong point to bring out in connection with this report.

[*A motion to adopt the conclusions at the end of Appendix B carried.* Chairman Cook then introduced G. M. O'Rourke (I. C.), sub-committee chairman, who presented the matter in Appendix C.

Assuming this has been read the committee considers it unnecessary to make detailed review on ballast cars, unloading and distributing, cleaning ballast, tie tamping, dressing ballast, track liners, and directs attention to the conclusions:

"1. The economy in the use of special equipment ballast cars, ballast cleaning devices, ballast shoulder shaping devices, tie tampers and track liners has been demonstrated and their use recommended.

"2. It is the recommendation of the committee that investigations along these lines be continued, a small number of labor-saving devices being selected for detailed study each year."

Tabulated data are shown in the addenda to this Appendix.

The committee is aware that this subject has been assigned to various committees in the past and submits this as a progress report only.

[This was received as information after which F. M. Thomson (M.-K.-T.) presented the matter in Appendix D on motor cars and *moved the adoption of the revision of the rules for the operation of motor cars, etc.*]

W. C. Barrett (L. V.): I think you will find these rules will be reported in the report of the Committee on Rules and Organization. I want to raise the question whether the committee wanted to have them printed twice.

The Chairman: These will be printed under the report of the Committee on Rules and Organization. It is given by this committee but will be printed under the report of that Committee.

[*The motion carried* and the committee was excused.]

Oiled Roadbed on the New Arizona Line of the Southern Pacific

Report on Economics of Railway Operation

The Committee on Economics of Railway Operation made a final report on the cost of stopping and starting trains which it has been studying for several years. The report also discussed the effect of motor transport on branch lines and described the method of abandoning a line of railroad. It also discussed the items which must be considered in comparing costs of operation and equipment maintenance. The committee reported progress on several methods of increasing the traffic capacity of a line and the more intensive use of facilities. On the latter subject two studies are under way whereby capacity may be increased without increased investment. Other studies were not ready for report. J. M. Farrin, the new chairman, has been a member of the committee since 1923.

J. M. Farrin
Chairman

THE committee submitted progress reports on: Methods of increasing the traffic capacity of a railway (Appendix A); methods of operation by which the intensive use of facilities may be secured (Appendix C); development of suitable units for comparing costs of operation and equipment maintenance (Appendix D); methods of determining volume of traffic and service conditions which will justify a change from flat switching to the hump method in yards (Appendix E); and branch line operation as effected by the introduction of motor trucks and bus lines (Appendix F). It also submitted a method of analyzing the costs of starting and stopping trains for inclusion in the Manual (Appendix B).

Committee: James M. Farrin (I. C.), chairman; F. H. McGuigan, Jr. (G. C. L.), vice-chairman; E. G. Allen (A. T. & S. F.), B. T. Anderson (C. & O.), G. E. Boyd (Ry. Age), G. D. Brooke (C. & O.), J. M. Brown (C. R. I. & P.), S. B. Cooper (West. E. & M. Co.), H. C. Crowell (Penna.), W. J. Cunningham (Harvard U.), L. E. Dale (Penna.), G. F. Hand (N. Y. N. H. & H.), Albert Hansen (B. & O.), Elmer T. Howson (Ry. Age), E. E. Kimball (Gen. Elec. Co.), M. F. Mannion (B. & L. E.), H. A. Osgood (Fulton Iron Wks.), L. E. Little (N. Y. N. H. & H.), H. T. Porter (B. & L. E.), J. F. Pringle (C. N. R.), L. S. Rose (P. & E.), Mott Sawyer (C. M. & St. P.), R. T. Scholes (C. B. & Q.), B. J. Schwendt (N. Y. C.), A. C. Shields (D. & R. G. W.), V. I. Smart (C. N. R.), M. F. Steinberger (B. & O.), J. E. Teal (C. & O.), F. L. Thompson (I. C.), Barton Wheelwright (C. N. R.), J. L. White (A. C. L.), C. L. Whiting (C. M. & St. P.), C. C. Williams (U. of Iowa), and Louis Yager (N. P.).

Appendix A—Method of Increasing the Traffic Capacity of a Railway

The policy of making studies of specific improvements to determine benefits derived was continued. The year's work involved studies of two double track installations, the data for which was not in shape for presentation. The committee expects to continue this study during the coming year.

Appendix B—An Analysis of the Costs of Starting and Stopping Trains

A method of determining the cost of stopping and starting trains was developed and the results that have been deduced from an analysis of the expense items incident to train service was submitted. In this analysis the cost of wages, locomotive and car repairs, depreciation and retirements were based on the time lost to productive service, while the remaining expense items were considered on the basis of the additional amount used because the train stopped as compared with these items on a non-stop train. The study was confined to through freight train operation as it was found impracticable to include passenger train operation.

Aside from the time element involved, which affects wage (when on overtime) and equipment costs, the principal items of expense are fuel and water. To determine these the study was based on a large number of dynamometer records which were obtained on the Chesapeake & Ohio during the summer and fall of 1925. These tests were made in through freight service with full tonnage trains, using Mikado locomotives having a tractive effort of 67,700 lb., on grades ranging from level to 1.25 per cent. The remaining items, which were determined on the basis of the amount used, including lubricants and other supplies for locomotives, and train supplies and expenses, were obtained by applying the ratio of that part of these accounts which would be affected by a train stop to the cost of the fuel and water. The method of doing this was outlined in considerable detail in the report.

Train stops were classified under three groups, each of which would be affected by the varying conditions under which they might be made. These were: (1) Anticipated schedule stops; (2) anticipated stops not scheduled; and (3) emergency stops.

The schedule stop does not normally involve serious loss in the hire of equipment, whereas the unscheduled may cause a serious loss in this item and may so interfere with schedules as to have a far reaching effect upon other trains, while an emergency stop may produce a noticeable damage to the rails and locomotive tires and increased brake shoe wear; in addition, such stops frequently result in the shifting of lading causing damage to both equipment and contents. It was not found practicable to outline rules for determining all the costs that pyramid by reason of unscheduled and emergency stops. Such costs can only be surmised and left to be considered as local conditions may warrant. For these reasons the study was confined to individual train stops that come under the three classifications mentioned.

While it was found impossible to develop a formula

for determining the cost of a train stop that can be applied generally and that such a formula would probably not be applicable on two different roads or two different divisions, or two different trains, and in many instances two different stops of the same train, the committee endeavored to develop a method by which the formulas can be readily adapted to the different conditions which may be encountered.

The report discussed in detail the various items which have been enumerated and developed formulas for the number of pounds of coal and gallons of water lost in stopping and starting freight trains on any grade. For the purposes of this study the cost of other supplies for train locomotives was estimated by multiplying the time lost on account of the stop by 30 per cent of the cost of this item per train hour for the train service involved. It was assumed that the cost of train supplies and expenses is not affected by the number of train stops made between terminals.

The cost of locomotive retirements, including interest on the investment in the locomotive, was based on the cost of ownership which was assumed to be 0.75 mills per pound of tractive effort. This value will vary for different roads and must be computed for each road before it is applied in the formula. The cost of freight train car repairs, depreciation and retirements on account of train stops is determined by the value of the car-day which was assumed at $1 per car-day, based on either the cost of ownership or the cost of hire in the same manner as these items apply to the locomotive.

The following recapitulation was given to show the items that should be considered in determining the cost of stopping and starting a 5,000-ton train consisting of 70 loaded cars, on an overtime basis, running at a speed of 25 miles an hour on a descending grade of 0.5 per cent, and accelerating it to the same speed on an ascending grade of 0.25 per cent.

	Cost
Wages for train and enginemen	$1.2944
Fuel for train locomotive	.7000
Water for train locomotive	.0467
Lubricants for train locomotive	.0247
Other supplies for train locomotivs	.0053
Train supplies and expenses.	
Locomotive repairs, depreciation and retirements, including interest on investment	.4972
Car repair, depreciation and retirements, including interest on investment	.6854
Total Cost	$3.2537

Appendix C—Methods of Operation By Which the Intensive Use of Facilities May Be Secured

This subject is so similar to that in Appendix A that it was decided to confine attention to the consideration of those means by which the capacity of a line can be increased without the expenditure of any considerable amount of money. This demarcation left a very limited field because relative few measures can be taken to increase capacity without the expenditure of money.

Two investigations were undertaken, both of which are in the early stages, as follows: (1) The use of the No. 19 train order in place of the No. 31 order as a means of reducing delays to trains thereby, increasing the number of trains that can be handled over the line in a given period; (2) a study of methods employed by the Canadian Pacific and Canadian National railways to handle their peak load grain traffic between Winnipeg and the Port Arthur —Fort William terminal each fall which involves the transportation of a maximum traffic for a period of approximately 60 days, equal to more than three times that handled during the remainder of the year. On the Canadian Pacific the number of freight trains operated daily between these points averages 10 during the 10 normal months, rising to an average of 35 and a maximum of 41 during the grain rush. The committee felt that a study of the methods by which this peak traffic is handled without increasing the investment that will be idle or little used during the remainder of the year will afford some interesting illustrations.

Appendix D—Suitable Units for Costs of Operation and Equipment Maintenance

Inasmuch as a liberal interpretation of the subject might have carried the scope of the study too far into the specialized fields of the transportation and mechanical departments, the committee concluded that, in the absence of arrangements for joint consideration with appropriate committees from those departments, it would be proper to limit this report to a brief survey of available statistical units and other data in the fields of train, locomotive, car, engine terminal, yard, and station operation and to confine it to the freight service. Specifically, the committee attempted to suggest an answer to such a question as this: In a case where there has been a substantial additional investment in such items as grade revision, reduction in distance, increase in double track, sidings, yard capacity, automatic signaling, and the like, what factors may be taken into account in comparing the operating results prior and subsequent to the expenditures to see whether the expenditures were justified?

Unfortunately it is rarely possible to paint a statistical picture which will reflect accurately the before and after results from the viewpoint of any single major factor, such as a grade reduction, a cut off, a program of additional trackage, a new engine terminal, or other extensive revision or enlargement of a terminal or an intermediate yard. Changes in the volume or the nature of the traffic handled, differences in weather conditions, changes in wage rates or working rules, fluctuations in the prices of materials and fuel, and differences in the number and degree of casualties, together with accounting exigencies which make it impracticable to avoid substantial adjustments which either adversely or favorably affect one or both of the two periods, frequently obscure or nullify the results which would be apparent had the traffic characteristics and all other factors been indentical in each period. A before and after comparison, therefore, is always surrounded by qualifications, many of which are not susceptible of exact measurement. Since, however, statistics at best are merely aids to judgment, and may properly be used only as such, the committee suggested units of performance, costs, and income that might be helpful in such a comparison.

Nothing was suggested that may not be compiled currently from available statistics of practically all railroads, and the greater part of the basic data are now required by the Interstate Commerce Commission in the monthly or annual reports to that body. An ideal scheme would embrace a more comprehensive schedule with many desirable subdivisions in detail (such as those in connection with locomotive and car repair costs), but the committee did not consider it advisable in this report to go beyond the available data except in a few instances to suggest

the desirability of greater detail. The committee merely suggested a summary of what it considered the best of the available and common units of comparison. They were grouped under three headings: (1) Physical performance—operating statistics in which the dollar mark does not appear; (2) unit costs—which are to be studied in connection with physical performance; and (3) traffic, revenue and income factors.

Appendix F—Effect of Motor Trucks and Bus Lines on Branch Line Operation

At the close of 1925 there were more than twenty million motor vehicles in use on the highways of this country, or more than one car for every six persons. The tremendous growth of motor transport since the World War has been accompanied by an equal growth in the mileage of improved highways. This mileage in the United States was estimated on January 1, 1926, at three million, of which one-half million or 17 per cent was surfaced. The rapid increase in the mileage of surfaced roads has made possible the corresponding increase in the number of motor vehicles. Possibly these facilities are not being used to capacity, but the unknown number of passenger miles and ton miles moving over the highways is so great that traffic on the railroads is being seriously affected.

Recent Trend in Rail Passenger Traffic

The number of passengers carried by rail reached its maximum in 1920, prior to the advent of motor transportation on a large scale; in 1925 the smallest number in the ten-year period was recorded—28 per cent fewer than in 1920 and 12 per cent below 1916, a pre-war year. The number of passenger miles also reached its peak in 1920, but the decrease since that year has not been so noticeable as in the case of the number of passengers. Before the World War there was a steady increase in passenger miles. A continuation of this increase would logically have occurred after the war; therefore the decrease that has taken place is especially significant.

While the decrease in the number of passengers carried has been general throughout the United States, it has varied widely in magnitude in different areas. Thus, while the number of passengers carried in the first nine months of 1926 is less than in the same period in 1922 in all districts, the amount of the decrease in these four years ranges from 1.3 per cent in the Great Lakes district to 41.7 per cent in the Southwestern district.

When the statistics of passenger travel are separated into those covering commutation traffic and those covering all other traffic, further light is thrown upon the source of the loss of passenger business. On the basis of the first nine months of the respective years, the number of commutation passengers increased from 319,197,000 in 1922 to 331,314,000 in 1926. The number of other than commutation passengers, however, decreased in the same period from 405,308,000 to 314,850,000, and this loss is primarily in the short haul traffic.

The average length of journey by rail, which was abnormally high in 1917, 1918, and 1919, due to troop movement, reached 40.5 miles in 1925, a longer distance than was recorded in any previous year in the period, and probably the longest ever reported in this country. The reason for this is that through long distance travel has been increasing and local, short distance travel has been decreasing. This decrease has not been in the commutation business that moves at less than standard rates, but in the first class ticket sales, generally considered the most profitable kind of passenger traffic. The net result of these two influences has been a more or less steady decline in passenger revenue since the peak in 1920, although an increase in passenger fares became effective late that year. Passenger revenue was smaller in 1925 than in any year since 1918. The decline in the sale of first class tickets is also reflected in the revenue per passenger mile, which has shown a steady decrease since 1921, the first full year in which the present schedule of fares was in effect.

As a result of the loss of this short haul traffic, the average journey per passenger has increased as is shown by the following figures for all passenger traffic for commutation passenger traffic and for passenger traffic other than commutation.

These reductions in passengers, passenger miles and passenger revenue are not the result of curtailment in passenger service; in fact, they have occurred in the face of a constant increase in the number of passenger train miles, this number in 1925 being greater than in any year since 1917, when troops were being assembled. As a result the average number of passengers per train decreased to 62.6 in 1925, the lightest loading since 1916. Similarly the number of car miles and the average number of cars per train have been increasing in spite of reductions in traffic, each item reaching a maximum in 1925, in which year the average number of passengers per car reached its minimum. Regardless of what may have happened in individual cases, the general statement may be made that the deflection of passenger traffic from rail to highway was not primarily the result of curtailment of rail service.

Highway Transportation Affects Rail Traffic

It is thought that the diversion of passenger business from the rail to the highway has been caused largely by the increasing use of the private automobile. In addition to the private car, the public conveyance or motor coach has made heavy inroads on rail passenger traffic in the last three years. On January 1, 1925, there were approximately 53,000 buses in service, virtually all of which had come into existence within the previous year or two, while on January 1, 1926, this number had grown to 70,000. Interurban electric lines and city rapid transit companies now own large fleets of motor coaches, and have thus protected their revenues. On the other hand, the steam railroads, with a few exceptions, have been slow to make use of this new method of transportation, with the result that some of the more profitable traffic has been captured by their new competitors. Some of the business will be recaptured by the operation of buses owned by the railroad or their subsidiaries.

The field of the motor coach outside of the cities should be limited to those sparsely settled districts where there is not sufficient traffic to justify the operation of passenger trains; to those districts where there is sufficient traffic to warrant the furnishing of both kinds of service (in which case the highway operation should be performed by the existing rail carrier); to those districts where accommodation train service can best be performed by buses in conjunction with express service by rail, the two forms of service being properly co-ordinated. Within its field bus transportation should not be opposed by the railroads; rather it should be encouraged by its adop-

tion wherever it presents the most economical method of transporting passengers. The duty of railroad management, therefore, appears to be the direction of the public's desires, so far as direction is possible, along proper lines, keeping highway transportation in its legitimate field, and not being slothful in providing it where it is the best transportation tool for the purpose.

It is significant that the average haul obtained by dividing revenue ton miles by tonnage originating on line has increased from 302 miles in 1916 to 332 miles in 1925, a figure that was not exceeded in the last ten years. It is a logical conclusion that this increase is due largely to the loss of short haul traffic to the motor truck. As in the case of the motor coach, the truck is well adapted to the furnishing of short haul transportation in limited quantities. In cities it is replacing the trap car for transferring less than carload freight between industries and freight terminals, and it is also replacing the freight car in intraterminal work. For short hauls of less than carload freight in city or country it provides cheaper and prompter transportation than the railroad train, especially when the cost of crating and packing and collection and delivery service are considered. In *retail* transportation it is preeminent; in *wholesale* transportation, measured either by bulk or by distance hauled, it is out of place and in its unregulated state a menace to rail carriers. It is probably not as serious a factor as the passenger car, because speed and economy govern its use, while in the case of the passenger car novelty and pleasure enter in to a large degree.

The field of the truck is limited in the same way as that of the motor coach, there can never be sufficient traffic to be moved, in bulk or over long distances, to warrant two parallel services save as a temporary expedient; rail facilities should be expanded, if necessary, to handle all of this business that is offered. Of course it is true that a sudden emergency, such as a war or a serious labor difficulty, may temporarily force wholesale freight traffic onto the highway. In the case of motor coaches, however, it is recognized that situations may exist where parallel services, covering relatively long distances, are justified and should be maintained. Generally speaking, the fields of the truck and the bus are the same and the attitude of the railroads toward the truck should be similar to their attitude toward the bus; assisting it in its legitimate field, using it as an ally where it should be used and opposing it elsewhere.

Branch Line Abandonments

It is evident that highway transportation has a great field in the sparsely settled areas served by railroad branch lines, and the effect of this new method of transport on the carriers' secondary lines is important. It is a matter of common knowledge that many rail lines have been abandoned in the last five years on account of deficits resulting from motor competition. It is also true that there are many rail lines now being operated at a deficit for the same reason; in general these should either be made to pay or be abandoned.

Unprofitable branch lines existed before the era of hard surfaced roads and motor transportation and to a limited extent abandonments were made. It is true, however, that the advent of motor transportation, both passenger and freight, on improved highways has had a great deal to do with increasing the number of losing branches and the degree of loss. The situation must be met, either by using these new transportation facilities where they should be used and by discouraging their use elsewhere, or by surrendering to the competitor and salvaging what remains of a formerly profitable business. Each case must be determined on its merits, as only general rules can be laid down.

The Public Will Decide

The right of the public to determine for itself the means it will use for traveling and shipping is well recognized by the Interstate Commerce Commission; the following is taken from a recent decision: "Applications for abandonment of steam railway operation appear to be only one of the many indications of disturbance resulting from the advent of the automobile and other industrial forces. The steam railroad is laboring under conditions which resemble in certain respects those encountered by the stage coach when the steam railroad came into the field. It will be admitted that people are entitled to the best and cheapest transportation they can get, and that they themselves must decide what is best and what is cheapest, all things considered. If people prefer to tax themselves to build great highways and to use commercial trucks and passenger vehicles in preference to the steam railroad, they have a right to their decision, but they must also assume the responsibilities, with the attendant consequences, of that decision."

As a result of all this strife, present and proposed regulation, fair and unfair competition, and the failure of the general public to figure accurately the cost of transportation that is provided partly by taxation, the railroad engineer has before him many new problems in the economics of branch line operation, the solution of which will require the highest analytical skill and a knowledge of virtually every branch of railroad business, including the fast growing portion that moves over the highway.

Discussion

[The report was presented by Chairman J. M. Farrin (I. C.) and the subject matter in Appendix A on revisions to the Manual, in Appendix B on analyzing costs, Appendix C on the use of facilities, and Appendix D on costs was accepted without discussion, following which Sub-committee Chairman R. T. Scholes (C. B. & Q.) outlined the work reported in Appendix E on switching operations.]

R. H. Ford (C. R. I. & P.): I think one of the reasons why the committee has not received as many replies to its questionnaire is the changing condition brought about by the car retarder. The Rock Island has had occasions last year to make an intensive study of its major yards, and in that connection has made a study of about eight yards throughout the country. We were impressed with the fact that what was economical and advantageous under some conditions on the property was very largely changed about when the car retarder was introduced. Perhaps the committee may well consider a review of its questionnaire to bring out the fact that the data should be separated to show the reasons why it reports as it does on the apportionment of the cost of changes where the car retarder is not used.

Chairman Farrin: The committee recognizes the influence of the car retarder, and in this questionnaire the question of the use or non-use of car retarders was included. I have made several studies of hump yards and have found in every case that retarder operation was the cheaper, but there is one disturbing influ-

ence that has come into this study. We have run across two cases where hump yards have been constructed and later taken out. I do not believe, therefore, that we should jump at any conclusions as to whether the hump yard is a proper thing or not. Sometimes it is, and sometimes it isn't. The studies made to date seem to indicate that when the volume of cars reaches about 1,500 per day, you are going to exceed the capacity of a flat yard, whereas a hump yard will probably take care of about 2,500 a day, working three shifts. Sometimes you can exceed 2,500, but day in and day out we find that 2,500 is a pretty good volume to put through any one yard. But the conclusions are not definite at the present time.

[Appendix E was adopted without further discussion, following which Appendix F on branch line operation was presented and adopted without discussion and the committee was excused.]

Report on Economics of Railway Location

No better evidence is afforded of the practical nature of the work being done by the American Railway Engineering Association than the character of the subjects covered in the report of the Committee on Economics of Railway Location since all of them deal with problems now definitely confronting railway managements. These are economics of railway location as affected by the introduction of electric locomotives, the relative merits of 0.4 per cent and 0.3 per cent grades and the relative merits of increasing tonnage by grade reduction or the introduction of more powerful locomotives. The report on the last subject is supplemented by two examples of actual studies of the problems involved. F. R. Layng is completing his first year as chairman of this committee.

F. R. Layng
Chairman

THE report comprised: (1) a Revision of the Manual (Appendix A); (2) a study of the economics of railway location as affected by the introduction of electric locomotives; (3) a study of the relative merits of a 0.4 per cent ruling grade as compared with a 0.3 per cent grade (Appendix C); and (4) the relative merits of different methods of increasing tonnage (Appendix D). The material in Appendix B was submitted for information; appendices C and D were progress reports; while the committee recommended that the changes in Appendix A be adopted for inclusion in the Manual.

Committee: F. R. Layng (B. & L. E.), chairman; H. C. Searls (M. P.), vice-chairman; F. L. Batchelder (C. R.), J. L. Campbell (S. P.), W. C. Coles (B. & O.), H. Fernstrom (Virginian), A. S. Going (C. N. R.), W. L. R. Haines (Penna.), L. G. Harris (A. T. & S. F.), C. P. Howard (I. C. C.), E. E. King (U. of Ill.), Fred Lavis (Cons. Eng.), Frank Lee (C. P. R.), W. S. MacCulloch (C. N. R.), Roscoe Owen (G. C. L.), F. M. Patterson (Ry Age.), C. L. Persons (C. B. & Q.), I. L. Pyle (C. & O.), A. R. Raymer (P. & L. E.), Edward C. Schmidt (U. of Ill.), A. K. Shurtleff (A. R. E. A.), L. O. Sloggett (I. C.), C. W. Stark (U. S. Ch. of Com.), P. E. Thian (N. P.), Walter Loring Webb (Cons. Eng.), W. H. Winterrowd (Lima Loc. Wks.), A. H. Woollen (I. C.), F. E. Wynne (Westinghouse El. Co.), M. A. Zook (M. W & S.).

Appendix A—Revision of the Manual

Four additions, one of which consisted of a definition which was omitted in the previous revision of the Manual were recommended. One of the revisions consisted of a correction of the text; two referred to extending engine runs, and one referred to the basis of computing train wages.

Appendix B—Economics of Railway Location As Affected by the Introduction of Electric Locomotives

Some Considerations for Electrification Studies

Every case of proposed electrification must be analyzed and decided on its merits, because the large number of variables comprised in railway operation makes it impossible to generalize with safety. The conditions most favorable to electrification are dense traffic, expensive fuel, bad or costly water, cheap power, prohibitive expense required for additional trackage or relocation, heavy grades, long tunnels and stub-end terminals. In making a study of electrification, certain operating costs are subject to rather exact predetermination, because the performance of electric motive power can be calculated accurately and is not seriously affected by operating conditions beyond the control of the designer. Cost of power, crew expense, reduction of facilities for fueling and watering, reduction or elimination of the non-revenue movement of fuel and water, and value of air rights released come in this category. Also savings in maintenance with adequate shop facilities may be predicted within reasonable limits. The full economic value of greater reliability, elimination of smoke and gases, reduction of delays, higher schedules, more frequent trains, elimination of forest fire hazards and such possibilities of electric operation are difficult to evaluate and must be based on judgment rather than on calculation.

The case with which the design of the electric motor may be adapted to meet the specific requirements of a particular service has resulted in numerous types of electric motive power with varied characteristics. A characteristic of electrical machinery is its ability to carry heavy overloads for short periods such as occur when starting a train or on short grades. Consequently while electric locomotives develop their maximum output in both tractive effort and horsepower during starting, they are rated at considerably lower values and their application must be made with full knowledge of the service conditions.

The most common form of traction motor is of the variable speed series type, capable of developing high starting tractive effort and with its speed increasing as the tractive effort demand decreases. On certain heavy grade electrifications, constant speed motors have been applied with admirable results, uniform train speed being maintained regardless of profile and alinement. With either of these simple types the rated output of the locomotive is developed at only a few speeds at most. Within the past three years has been developed and placed in service the motor-generator type of locomotive which develops its rated output over a fairly wide speed range.

Where long heavy grades are encountered, regenerative braking is provided on electric locomotives. In addition to affording the maximum degree of safety for down grade operation, this feature produces definite economy by reducing wear and tear on equipment and decreasing the amount of electric energy used.

Even in a preliminary economic study of electrification it is necessary to make some analysis of present operating conditions and their possible modification with electric motive power; to choose tentatively the system of electrification, a type and size of motive power unit, a type of overhead construction, the number and capacity of substations, and the kind of transmission line; to approximate the energy requirements; and then to apply the costs with discretion.

The extreme flexibility of the electric motor in its adaptation to a specific duty through variations in design, mounting and method of connection to the locomotive driving wheels has tended to prevent standardization and resulted in extreme variations in tractive effort per unit weight. The higher values of rated tractive effort are secured on switching, freight and modern speed passenger locomotives while the lower rated tractive efforts occur principally on high speed passenger types.

Appendix C—The Relative Merits of a 0.4 Per Cent Ruling Grade As Compared with a 0.3 Per Cent Grade

The reduction of grades is a question of economics and all the conditions peculiar to each operating division on which a study is to be made must be taken into account. As a broad assumption it may be stated that while a 0.4 per cent ruling grade is good, a 0.3 per cent grade is better and a 0.2 per cent grade is still better, provided there be the traffic to justify the cost of securing it.

The studies made by J. B. Berry, formerly chief engineer of the Union Pacific, have been of great value, yet one must accept with caution his statement on page 699, Volume 5, of the Proceedings of the A. R. E. A., that "No advantage, except a reduction of time, would be gained by reducing grades below 0.4 per cent, as the starting resistance of trains on the level would limit the weight of the train." The improvements in car trucks and bearings and the generally higher standard of track maintenance have undoubtedly been factors in modifying the applicability of this statement, for at present the performance of trains on grades of 0.3 per cent or less seems definitely to controvert it, even where boosters are not used. While there may be a limit below which it is not economical to reduce grades on account of starting resistance and because of the difficulties incident to proper drainage, the general opinion, based perhaps more on observation than on actual tests, seems to be that 0.2 per cent is that limit. The increasing use of the locomotive booster and the possible use of roller bearings for freight cars are developments that may exert profound changes in the studies for grade reduction. The use of stokers or of oil fuel have also modified the former limits for long grades by eliminating the element of human fatigue.

The objection has been made that the benefits to be gained by a reduction of the ruling grade are often rendered nugatory on account of the increased train load slowing up the movement over the other parts of the road. The present tendency is to speed up the movement of freight trains and unquestionably there are many places where grade reductions made on the basis of drag tonnage trains are not giving satisfactory results under the changed conditions that prevail at present. The average speed of the trains over the road is one of the factors to which weight must be given in any grade reduction study, and if proper consideration be given to this element there need be no misgivings as to results.

This was taken into consideration in a relocation 17 miles long to reduce grades on the Burlington near Beardstown, Illinois, on a line whose traffic consists largely of coal from southern Illinois fields. This line from Herrin to Galesburg, a distance of 261 miles, has no grades northbound heavier than 0.3 per cent. The new line, which has a continuous ascending grade to the north, was built to a gradient of 0.25 to eliminate the delay that a grade of 0.3 per cent would entail to tonnage trains and the results have been all that were expected. When it is considered that the passenger traffic and fast freight traffic on this line is almost negligible, the importance of similar treatment on lines having a considerable proportion of fast traffic will be recognized. There will surely be no controversy over the statement that a train of any tonnage can run faster on a light grade than it can on a heavy one.

As has been said, the amount that a road can afford to spend for grade reduction must be based upon a consideration of all conditions to be met on any given project. According to a study made by C. A. Morse, chief engineer of the Chicago, Rock Island & Pacific, an expenditure of $950,000 was justified for each 0.1 per cent reduction in the ruling grade for a line handling about 14,000 tons of freight each way and a similar value was arrived at in an independent study for grade reduction on the Santa Fe. It is interesting to note that Clement C. Williams and the late Wm. G. Raymond give similar, but somewhat higher, figures for the capitalized saving for each 0.1 per cent reduction in the ruling grade.

Appendix D—Relative Merits of Different Methods of Increasing Tonnage

The committee studied the relative merits of increasing tonnage by the reduction of ruling grades, the introduction of more powerful locomotives, including consideration of momentum grades, and the availability of the locomotive booster. It was found impossible to formulate any general rule which will afford a comparison of the relative merits of the several methods of increasing tonnage. However, it is almost axiomatic that no two problems involved in such a comparison would be in all respects the same, and any variations in the elements of the problem would produce a difference in the result.

The committee called attention to some of the factors which must be considered and to the methods that may be followed in making such an analysis. In the factors which were given consideration were:

(1) The initial expenditure required for (a) grade reduction, and (b) for the installation of boosters, or for the purchase of heavier power, taking into consideration the normal expenditures for the renewal of power in kind. Heavier power frequently necessitates the strengthening of bridges, enlarging of tunnels and revisions at points where clearances are close, the installation of longer turntables, rebuilding of engine houses, revision of frog and switch layouts at terminals and similar expenditures.

(2) Effect on maintenance costs, both maintenance of way and maintenance of equipment.

(3) Effect on transportation costs and taxes. This item must be given consideration in connection with savings due to a reduction in the number of trains by increasing train loading, the additional cost of operating heavier locomotives, and the effects due to increased or decreased distance, rise and fall, and curvature.

(4) A factor of considerable importance which is frequently neglected is the *character* of the business handled. This as well as the *volume* must be given consideration.

(5) As a corollary to the character of the traffic, consideration must be given to the necessities of scheduled movements particularly with regard to interchange with adjacent divisions. Where traffic consists largely of commodities requiring fast movement it might prove more profitable to use heavier power than to revise grades.

(6) A factor of some importance in deciding between grade revision and the use of heavier power may be the relative ease or difficulty of obtaining the necessary money. The purchase of heavier power can usually be accomplished under the equipment trust plan while the money for major improvements generally must be obtained in other ways. Furthermore, the expenditure for power is less in amount usually, and usually productive of quicker savings than for grade revision. On the other hand, grade revisions, once accomplished, will usually prove profitable in other ways than by the increase in tonnage. They should prove of benefit to all trains whether lightly loaded or loaded to the full capacity of the locomotive, making possible greater speed or a reduction in the fuel consumption.

This Appendix also contained two studies of grade and line revisions made by railroads in which the relative merits of two or more rates of ruling grades were compared.

Discussion

[The report of the committee was introduced by Chairman F. R. Layng (B. & L. E.) who asked H. C. Searls (M. P.), sub-committee chairman, to present the revisions of the Manual in Appendix A. He outlined the changes offered and *his motion for their adoption was carried.* The matter in Appendix B was presented by F. E. Wynne (Westinghouse Elec. & Mfg. Co.) a member of the sub-committee who had prepared a paper on the economics of railway location as affected by the introduction of electric locomotives.]

R. H. Ford (C. R. I. & P.): In considering the question of grade reduction, has the committee considered the possibilities of electric operation? The point I want to make is, that on account of the great increase in traffic, a great many railroads must reduce their grades. It is probably predicated to some extent on the steam locomotive, but the electric operation introduces an additional factor.

Mr. Wynne: Mr. Ford is right that conditions are quite different from what they used to be. The committee has not made any direct comparison between possibilities of any engine district with electric operation and with grade reduction. I might say, however, that in a number of instances both in this country and abroad comparisons have been made in mountain districts between the costs and economies that could be expected from grade reduction and those which could be expected from electrification, and in a number of these instances electrification has been adopted as the correct solution.

Mr. Ford: I think there is another factor that the speaker has not touched upon. There has been a tendency throughout the country generally to feel that the next step is electrification. I don't think that we have taken into consideration fully, the great advance in the improvement of the steam locomotive. I don't think it is a question of dismissing the subject merely with the inference that we won't reduce the grades because we will probably electrify. I hope the committee, during the next year, will study the possibilities of the steam locomotive as compared with the electric locomotive.

W. W. Winn (S. P.): Everything that Mr. Ford has said is perfectly true and I think it will be well to suggest that the chairman of the committee follow along the lines suggested. Steam locomotives have made marvelous progress in the last few years and we are faced with comparing a modern steam locomotive in every case with a modern electrical locomotive, taking into consideration what grade reduction will do in each case.

S. S. Roberts (I. C. C.): I can't quite see the difficulties some of the speakers have raised. It might be that the electric locomotive because of the excess power it might have for a short time, would be able to negotiate a heavy grade which you might have to reduce for a steam locomotive, but with that exception I do not see that the problem is complicated. In considering any grade reduction you have a certain elevation over which you have to lift the train. It is not going to take any more work to lift that train with an electric locomotive than it is with a steam locomotive.

G. D. Brooke (C. & O.): There are many grades in this country which, if reduced, would require such length of tunnels that the new line could not be operated except electrically. There is one case in which grade reduction is absolutely dependent upon electrification. It has always seemed to me that the great opportunity for electrification will come in another era of building new lines on this continent, or some other continent, when the projectors of the new line will be able to start with a clean slate. In electrifying existing lines the problem of disposing of the existing steam motive power, existing shop facilities, and such things, is encountered.

Take for example a new line, say 100 miles long, to be built over broken country, generally laying across water sheds which would require a broken grade line. If the projectors contemplate within a reasonable future time the handling of the heavy traffic, they would doubtless be justified in building a comparatively low grade line if steam power had to be depended upon. That low grade line under the topographical condition would be costly of operation. The stream crossings would doubtless be high and it would be necessary to build comparatively long tunnels at the summits or use heavy cuts, and a good deal of the line would doubtless have to be built on rather high support.

On the other hand, if the line is designed for electric operation, heavier grades could be used, the stream crossings would be placed as low as practicable, taking into consideration flood stages of the streams. The summits could possibly be somewhat higher and in following the tributary streams, the line could be placed simply above the high water rather than on support. In that way a great saving in construction costs could be made and the money thus saved probably could be used in constructing the power lines, providing the copper and possible additional cost of electric locomotives. There would doubtless be some saving also in repair shop facilities. Here, possibly, is the best application of this particular phase of the committee's work.

W. H. Kirkbride (S. P.): We should approach this subject of electrification with a great deal of care and caution. There have been sufficient incidents in the past to show that possibly sufficient attention had not been given to all the problems. The previous speaker referred to the necessity of electrification on account of tunnels. That generally is true, but I have in mind a case where electrification was avoided by reversing the grade of the tunnel. In other words, a long tunnel was constructed with a descending grade in the direction of traffic, it being recognized that a steam engine or locomotive even with heavy tonnage could descend a grade without creating gas or smoke nuisance. That tunnel is successfully operated.

There is also this fact to consider, that the various legislatures of the states are passing laws regulating the number of cars that can be hauled in a train. This problem is a fluctuating problem, depending on the attitude of the politician, you may say, as well as the labor unions. What we have today we do not have tomorrow. Therefore serious consideration must be given to the ultimate length of trains or the number of cars in the train.

The question of fuel cost is a fluctuating one. We sometimes think, and I presume it is a rather general opinion, that hydro-electrical power is very cheap, that it is the panacea for all of our ills in connection with railroad operation. I believe I am safe in making the statement that such is not a fact. In the West it has been proven that with cheap gas and cheap fuel oil, you can generate electricity with those fuels as cheaply as you can by water power. However, fuel oil will enable you to operate your trains by steam locomotives for a long period until that relative cost of power changes.

J. B. Jenkins (B. & O.): Mr. Brooke referred to a much needed grade reduction which would require a tunnel of enormous length. The question comes up there since electrification is needed. If you have the grade reduction, couldn't electrification alone accomplish everything that would be accomplished by grade reduction? It is not true, as one speaker mentioned, that a summit of a given height is the same thing for electric locomotive as it is for a steam locomotive. If there is sufficient density of traffic, the current generated by the train going down one side of the grade can lift the train going up the other side, so that the question of the economies to be introduced by electrification deserves serious consideration against the economies accomplished by grade reduction. I think the question should be grade reduction versus electrification.

F. L. Batchelder (Copper Range): The sub-committee has had under consideration the development and improvement of the steam locomotive, and we may be able to make some report on this later. The introduction of electric power would enable traffic to be handled at a lower expense, everything considered, than a grade reduction—that is, if the earnings are not greater and more than offset the difference in the cost of electrification and grade reduction, then electrification should be considered. But each question must be considered on its own merits, and the problem of net income is the one which should rule. In making these investigations, however, an attempt is being made reasonably to discount future developments.

[In the absence of the sub-committee chairman, C. L. Persons (C. B. & Q.) the matter in Appendix C was presented by F. M. Patterson *(Ry. Age).*]

Mr. Ford (C. R. I. & P.): I am sorry the committee didn't see fit to elaborate a little on that even though it is reporting as information. There is a possibility, that this will ultimately develop so that the average railroad man may have a yardstick, if you please, that will give him some way of getting these comparisons. There isn't any question but that there has been a large amount of money spent unwisely or unnecessarily, possibly, because of the absence of just that type of information.

It isn't a question as to whether we are going to reduce grades. We are assuming that is settled, but it is a question as to whether it is desirable to go on to a 0.3 or 0.4 grade. One or our trunk lines is considering very seriously going to a 0.2 grade. The matter is so important that I hope next year the committee will do two things: first, at least report the information which is available today on many of the railroads.

Chairman Layng: We appreciate very much the suggestions of Mr. Ford. I am glad he emphasized several of the larger projects that are now being constructed, or that have just been put in service. The committee has found some difficulty in getting the information it needs from the members of this association on some of these projects. In one case it was found necessary in this report to use fictitious names to illustrate a particular case. The committee needs your support. [Sub-committee chairman W. L. R. Haines then introduced the report on Appendix D.]

Maurice Coburn (Penna.): It seems to me these two methods of analysis are dangerous things and should not be published. In this first one no attention is paid to the time element. When you make a grade change you slow up the movement over most of the road. There is only one way to figure that kind of a job and do it right, and that is to figure the round trip cost and know how it is affected by the changes in the railroad. Another thing that has been left out is the fact that we never get 100 per cent rating. Our potential is 60 or 70 per cent and we are lucky if we get that the year round. That affects it very decidedly. In making these figures the averages which have been used by the accounting department for distributing costs are used. Those are very misleading. That may be an easy way of meeting requirements of the accounting department but they don't tell anything about the cost we ought to know. As you increase the train load you increase the fuel. In these figures the cost per train mile is the same for an engine for a train loaded up to the limit on 0.3 grade as for a pusher coming back light. The fuel cost is not included in the cost of handling the fuel. Every time you try to use some figures like this you are going to fool yourselves. This doesn't correlate with the previous report. The report before this discussed the need of considering time. The second report is misleading in the same way. They are using some of the methods out of date nearly twenty-

five years. I am sure there are members on this committee who know better than that.

Mr. Haines: The speaker must have overlooked a great many things in the report. The first criticism in regard to the factor of time element not being taken into consideration is not correct, because all of these calculations were predicated on the fact that a train run would be made within the specified hours of service. The runs on the particular division which was under consideration were so arranged that they would be made within the eight-hour limit and wages are paid on the basis of a 100-mile run in eight hours. Round trip traffic was taken into consideration. The rating of the trains was carefully gone over with the operating people of the division, the freight trainmaster and division superintendent, and the ratings adopted were those suggested by them. It was 95 per cent of the normal as representing the average for the year-round for slow freight and 75 per cent of the normal as representing the average the year-round for fast freight. With regard to the train mile costs, I admit there is a great deal of difficulty in getting any figures which can be applied with exactness, and particular mention is made of that in the report. The costs as used are perhaps as close to the average for low grades as they would be for a high grade. They are undoubtedly higher, and the costs as used in this report do not correctly represent the actual costs that would be effected.

Chairman Layng: Replying to Mr. Coburn just a little further as to the data in the other illustration being 25 years behind times. I just want to say to him that that data came from a railroad that is far from being 25 years behind the times. I regret very much I can't give him the name of the railroad, but I am quite sure if I did he would have more confidence in the figures used. The fact is, regardless of his opinion, those are figures that are being used by this railroad today.

[The committee was dismissed with the thanks of the Association.]

Report on Iron and Steel Structures

While the Committee on Iron and Steel Structures has a long list of assigned subjects, it has consistently adhered to the policy of concentrating attention on those particular assignments which offer opportunities for definite action. As a consequence, it usually has well considered material to offer on a limited number of items. In this year's report, the chief feature is a set of specifications for waterproofing which is offered for approval by the association. There is also a report on a series of tests for determining the bearing value of large rollers and an abstract of a report made in India on the effect of impact on railway bridges. B. R. Leffler is completing his first year as chairman of this committee but has been a member for the past 13 years and has served as vice-chairman for 5 years.

B. R. Leffler
Chairman

THE committee's report included (1) a brief statement of progress on the revision of the Manual in Appendix A; (9) Specifications for the Waterproofing and Drainage of Solid Floor Railway Bridges (Appendix B); (11) Instructions for Maintenance Inspection of Superstructures of Steel Bridges, collaborating with the Committee on Rules and Organization (appearing in the report of the latter committee); and (13) a Report on an Investigation of Bearing Pressures on Large Rollers. This appeared in Appendix C and is an abstract of Bulletin No. 162, Engineering Experiment Station, University of Illinois. In addition to the above, the report included an Appendix D containing an abstract of technical paper No. 247 of the Railway Board of the Government of India dealing with impact for moving loads on railway bridges. Appendix B is abstracted below.

The committee recommended (1) that its progress statement on the revision of the Manual be accepted as information; (9) that the specifications for waterproofing (Appendix B) be adopted and placed in the Manual and (11) that the report on large rollers be received as information.

Committee: B. R. Lefler (N. Y. C.), chairman; A. R. Wilson (Penna.), vice-chairman; P. S. Baker (Reading), J. E. Bernhardt (C. & E. I.), A. W. Carpenter (N. Y. C.), M. F. Clements (N. O.), O. F. Dalstrom (C. & N. W.), R. P. Davis (U. of W. Va.), F. O. Dufour (Lafayette, Cal.), Thos. Earle (Beth. Steel Co.), W. R. Edwards (B. & O.), G. H. Gilbert (Sou.), G. A. Haggander (C. B. & Q.), C. S. Heritage (K. C. S.), O. E. Hovey (Am. Brg. Co.), J. B. Hunley (C. C. C. & St. L.), P. G. Lang, Jr. (B. & O.), Crosby Miller (C. & O.), P. B. Motley (C. P. R.), Albert Reichmann (Am. Brg. Co.), A. F. Robinson (A. T. & S. F.), H. N. Rodenbaugh (F. E. C.), O. E. Selby (C. C. C. & St. L.), I. L. Simmons (C. R. I. & P.), P. B. Spencer (N. Y. N. H. & H.), R. O. Stewart (C. N. R.), H. B. Stuart (C. N. R.), R. M. Stubbs (M-K-T.), G. H. Tinker (N. C. & St. L.), G. H. Trout (U. P.), F. E. Turneaure (U. of Wis.), F. P. Turner (N. & W.), H. T. Welty (N. Y. C.), W. L. Wilson (Lehigh U.), and W. M. Wilson (U. of Ill.).

Appendix B—Specifications for the Waterproofing and Drainage of Solid-Floor Railway Bridges

(I) General

1. These specifications apply to membrane waterproofing, which is the only kind recommended for solid-floor railway bridges. The waterproofing shall consist of a membrane covered by a protection course of brick, concrete, or asphalt mastic.

(II) Design of Bridge

2. The bridge shall be so designed that it will be adapted to waterproofing by the methods and with the materials specified herein. Special attention shall be given in the design to construction joints, expansion joints, flashing, and drainage. The number of construction joints shall be a minimum. Stiffness is an essential feature. Where

contraflexure would injure the waterproofing, special details shall be provided.

3. The application of waterproofing under traffic should be avoided.

4. Surface to be waterproofed shall be easily accessible, smooth, and of simple form. Open spaces, joints, holes pockets, seams, projections, and other features that would increase the difficulty of waterproofing, shall be avoided.

5. Concrete floors shall be of ample thickness, and of nonporous concrete. Special attention shall be given to the quantity and distribution of the reinforcement.

6. Adequate drainage shall be provided by means of grades which will shed the water by the most direct route. A grade of at least one per cent is desirable; grades from points which are difficult to waterproof or drain should be steeper. Surfaces of the floor shall slope away from the joints.

7. Conductor pipes shall be of wrought or cast iron, not less than four inches in diameter, preferably without bends, easy to install and maintain, and protected against clogging or injury. Where low temperatures occur, it is not desirable to encase conductor pipes in concrete. Clean-outs shall be provided if conductor pipes cannot be cleaned otherwise. Gutters preferably shall be of the open type. They shall be of durable material, easy to install and maintain.

8. Outlets for the harmless escape of drainage shall be provided.

9. Waterproofing shall extend above the highest probable level of water or melting snow.

10. The upper edges of contact between concrete and steel shall be grooved and filled with elastic cement, or protected by metal flashing.

11. The reinforcement in the concrete protection course shall be placed in the middle of the layer of concrete.

12. The edges of the waterproofing shall be protected against percolation and capillary action by means of drip beads.

(III) Types of Waterproofing

13. The waterproofing membrane shall be made up of layers of bitumen-treated cotton fabric, or felt and cotton fabric, with alternate moppings of bitumen, either asphalt or coal-tar pitch.

The following types of membrane are recommended:

Type A. Two layers of asphalt-treated cotton fabric and three moppings of asphalt.

Type B. Three layers of asphalt-treated cotton fabric and four moppings of asphalt.

Type C. Two layers of asphalt-treated felt, one middle layer of asphalt-treated cotton fabric, and four moppings of asphalt.

Type D. Two layers of pitch-treated felt, one middle layer of pitch-treated cotton fabric, and four moppings of coal-tar pitch.

Type E. Four layers of asphalt-treated felt, one middle layer of asphalt-treated cotton fabric, and six moppings of asphalt.

Type F. Four layers of pitch-treated felt, one middle layer of pitch-treated cotton fabric, and six moppings of coal-tar pitch.

At places requiring greater strength, additional layers of bitumen-treated cotton fabric shall be applied.

Other types may be used at the discretion of the Engineer, but the mopped-on material shall be the same as that with which the felt or fabric is treated.

The first mopping of bitumen shall be placed on the surface to be waterproofed and shall be followed by alternate layers of fabric or felt and moppings of bitumen, ending with a mopping of bitumen on top.

(IV) Materials

Asphalt for Mopping and Saturant—14. Asphalt for mopping and saturant shall be homeogeneous and free from water. It shall be the product obtained by the distillation of crude asphaltic base petroleum refined by direct heat without the addition of fluxing or other material during any stage of the process of manufacture. It shall meet the following requirements:[1]

Asphalt for Mastic—15. Asphalt for mastic shall be homogeneous and free from water. It shall meet the following requirements: [Same as A. S. T. M. Standards Serial Designation D163-23T.]

[1]Same as A. S. T. M. Standards, Serial Designation D 144-25, except as follows:
(b) Penetration at 77 deg. F. 25 to 40 instead of 25 to 50.
(d) Loss on heating 0.5 per cent instead of 1.0
(e) Penetration of residue after heating, 80 pe 60 per cent.
(f) Ductility 20 cm. instead of 15 cm.

Coal-Tar Pitch—16. Coal-tar pitch shall be homogeneous and free from water. It shall meet the following requirements: [Same as A. S. T. M. Standards Serial Designation D145-25.]

Elastic Cement—17. Elastic cement shall be an asphalt homogeneous and free from water. It shall meet the following requirements:

(a) Softening point (ring and ball method)—120 deg. to 130 deg. F. (48.8 deg. to 54.4 deg. C.).
(b) Penetration: at 115 deg. F. (46.1 deg. C.), 50 g., 5 sec.—not more than 300; at 77 deg. F. (25 deg. C.), 100 g., 5 sec.—50 to 60; at 32 deg. F. (0 deg. C.), 200 g., 60 sec.—not less than 15.
(c) Loss on heating at 325 deg. F. (163 deg. C.), 50 g., 5 hr.—not more than 0.5 per cent.
(d) Ductility at 77 deg. F. (25 deg. C.)—not less than 85.

The cement shall be of such a quality that it will form a complete and permanent bond with the adjacent materials. The volume shall not be reduced on exposure to weather, except by change of temperature.

Fabric—(Articles 18 to 28 inclusive) [Conform closely to A. S. T. M. Standards Serial Designation D173-25.]

Felt—(Articles 29 to 39 inclusive) [Conform closely to A. S. T. M. Standards Serial Designation D172-23T.]

Brick—40. Brick for the protection course shall be dense, hard burned, uniform in size and quality, free from warp and have square corners. The absorption of moisture by bricks immersed in water seven hours shall not exceed 10 per cent of the weight of the dry brick.

Concrete—41. The materials used in the concrete protection course shall meet the requirements of the current specifications for concrete, of the American Railway Engineering Association.

Asphaltic Primer—42. Asphaltic primer shall be composed of asphalt and a solvent. The asphalt shall meet the requirements for asphalt in Section 14. The solvent shall be a hydro carbon distillate having an end point, on distillation, not above 500 deg. F. (260 C.). Not more than 20 per cent shall distill under 248 deg. F. (120 deg. C.).

43. The primer shall be free from water and shall meet the following requirements:

(a) Sediment.....not more than one per cent
(b) Asphaltic base, by weight.....25 to 35 per cent

Asphalt Mastic—44. Asphalt mastic shall be either pre-moulded blocks or poured-in-place mastic.

Poured-in-place mastic shall be composed of (a) asphalt mixed with mineral aggregates, or (b) mastic cake mixed with asphalt and mineral aggregates.

Asphalt—45. Asphalt for mastic shall meet the requirements of Section 15.

Coarse Mineral Aggregate—46. Coarse mineral aggregate shall be well graded crushed stone or washed gravel, that will pass a ½-in. screen and be retained on a No. 10 screen. It shall be free from soft particles and organic matter.

Fine Mineral Aggregate—47. Fine mineral aggregate shall be well graded washed sand or crushed stone, that will pass a No. 10 screen. It shall be free from soft particles and organic matter.

Mineral Filler—48. Mineral filler shall be finely ground limestone or silica meeting the following requirements:

(a) Passing a 200 mesh sieve.....not less than 50 per cent
(b) Passing a 30 mesh sieve.....not less than 90 per cent

Portland Cement—49. Portland cement shall meet the requirements of the current specifications for Portland cement, of the American Railway Engineering Association.

Mastic Cake—50. Mastic cake shall contain from 14 to 18 per cent by weight, of matter soluble in pure benzol. The soluble matter shall be asphalt which will meet the requirements of Section 15.

The insoluble matter shall be granular mineral matter, which will meet the requirements of Sections 47, 48 and 49.

Pre-moulded Blocks—51. Pre-moulded blocks shall meet the following requirements:

(a) They shall be 4 in. wide, 8 in. long, and 1¼ in. thick. A deviation of ¼ in. in length or ⅛ in. in width or thickness either way from these dimensions, shall be cause for rejection.
(b) The blocks shall be formed in moulds, under a pressure of not less than 3,300 lb. per sq. in. of surface. An absorption test shall be made on blocks dried for 24 hours at a temperature of 150 deg. F. (65.5 deg. C.) and then immersed in water seven days. The absorption of moisture under this test shall not exceed one per cent of the weight of the block.

Reinforcing Material for Concrete Protection—52. Reinforcing material shall be steel wire netting with a mesh not

less than two inches. The wire shall be not smaller than No. 14 gage.

Insulating Paper—53. Insulating paper shall be a waterproof paper 36 in. wide and weighing not less than 10 lb. per 100 sq. ft.

Marking—54. Bituminous materials, fabric, and felt shall be delivered on the work in the original packages bearing the manufacturer's brand or label. The kind of saturant for the fabric and felt shall be indicated.

Inspection and Tests—(Articles 55, 56, 57 and 58) [omitted.]

(V) Application

General—59. Waterproofing shall not be done in wet weather nor at a temperature below 50 deg. F. without permission from the engineer.

60. The work shall be done by competent workmen, skilled in the kinds of work specified.

Preparation of Surfaces—61. Surfaces of concrete and steel to be waterproofed shall be smooth and free from projections which might injure the waterproofing membrane. The surface shall be cleaned of dust, dirt, grease and loose particles. The use of hand bellows is recommended for removing dust and loose dirt from corners and joints. For removing grease from the steel, freshening the surface of the asphalt where a joining of old and new is to be made, or where elastic cement is to be applied against the steel and the membrane or the protection course, gasoline shall be used. The gasoline may be applied by swabbing or by pouring on a small quantity and setting fire to it. A blow torch also may be used. The surface shall be clean and dry when the waterproofing is applied. Damp surfaces may be dried by covering with a layer of hot sand. The sand shall remain in place one or two hours, after which it shall be removed from enough surface to allow the work to proceed. Another method is to swab with gasoline and set fire to it.

Priming Coat—62. If specified by the engineer, surfaces of concrete or steel coming in contact with asphalt waterproofing shall be given one coat of asphaltic primer. The primer shall be thoroughly worked in to give a uniform coating.

63. Priming shall be done immediately before applying the waterproofing membrane. The priming coat shall be dry before the membrane is applied.

Floating Membrane—64. If bond between the membrane and the surface to be waterproofed is not desired, the surface shall be covered with insulating paper meeting the requirements of Section 53.

Workmanship—65. The felt or fabric shall be laid single fashion with the specified number of layers, and with the top layer lapped two inches over the bottom layer. Each strip shall be laid in a mopping of hot bitumen and, when the specified number of layers has been laid, the entire surface shall be mopped. If practicable, the laying of the felt or fabric shall be begun at the lowest part of the surface to be waterproofed. The surface shall be completely covered with a heavy mopping of bitumen before the strip of felt or fabric is put down. The mopping shall be so done that there will be no air bubbles or pockets, or spots where the surface shows through. If fabric is used, this mopping of bitumen shall be sufficient to fill the open meshes in the fabric when it is pressed down. As soon as a strip of felt or fabric has been laid, it shall be pressed into the hot bitumen to eliminate the air bubbles. Creases in the fabric shall be smoothed out carefully by pulling the fabric. The top mopping shall be of such thickness and be so applied as to seal and cover the fabric or felt completely.

66. Special care shall be taken that the felt or fabric is completely sealed down at the laps. The waterproofing membrane shall be continuous and unbroken. The work shall be so regulated that at the end of the day, the fabric or felt that has been laid will have received the final mopping of bitumen. At joints in the membrane, the laps shall be at least 12 in. The felt or fabric for making the lap shall be left unmopped until the joint is to be completed.

67. The amount of bitumen in each mopping of 100 sq. ft. of surface shall be not less than 4½ gal.

68. Care shall be taken to avoid overheating the bitumen. The temperature of the bitumen in the kettle shall not be above 350 deg. F., and not below 250 deg. F., just before the bitumen is placed in the work. Kettles shall be equipped with thermometers.

69. Special care shall be taken to make the waterproofing effective along the sides and at the ends of girders, and at stiffeners, gussets, etc.

The waterproofing membrane shall be turned down into the drainage casting without a break.

70. Waterproofing shall be protected against mechanical injury, high temperature, and chemical action, as soon as possible after completion.

Concrete Protection Course—71. The concrete protection course shall not be less than 1½ in. thick, and reinforced as required by the plans. The concrete shall be 1-2-4 mixture of a consistency as dry as is workable. The size of the coarse aggregate shall not exceed ½ in. The top surface of the concrete shall be true to grade and troweled to a smooth finish.

72. Unless approved by the engineer, trains shall not be allowed over waterproofed surfaces until the concrete deposited last has had the equivalent of seven days of good curing weather.

Brick Protection Course—73. The brick protection course shall be laid over the entire membrane, except around the drainage castings and other places shown on the plans. In such places concrete shall be used.

74. The laying of brick shall follow the waterproofing closely, and the joints shall be filled immediately. Unless otherwise specified, the joints shall be filled with bitumen of the kind used for the waterproofing. The bricks shall be dry when the joints are filled.

Asphalt Mastic Protection Course—75. The pre-moulded block protection course shall be laid over the entire membrane, except around the drainage castings and other places shown on the plans. In such places poured-in-place mastic or concrete shall be used.

76. The laying of the blocks shall follow the waterproofing closely. The blocks shall be laid in hot asphalt and the joints shall be filled immediately with asphalt. The asphalt shall meet the requirements of Section 15.

77. The poured-in-place mastic protection course shall be not less than 1½ in. thick, and shall be laid on one thickness of insulating paper on the membrane. The insulating paper shall meet the requirements of Section 53.

78. Asphalt and mineral aggregates shall be mixed in the following proportions:

Asphalt	9 to 12 per cent
Coarse mineral aggregate	35 to 40 per cent
Fine mineral aggregate	33 to 37 per cent
Portland cement or mineral filler	15 to 19 per cent

The proportions should be varied to give a mastic of the greatest density and stability.

79. Mastic cake, asphalt and mineral aggregates shall be mixed in about the following proportions:

Mastic cake	48 per cent
Asphalt	5 per cent
Fine mineral aggregate and cement or mineral filler	19 per cent
Coarse mineral aggregate	28 per cent

The proportions should be varied to give a mastic of the greatest density and stability.

80. The asphalt and the mastice cake shall be heated to 350 deg. F. The aggregates shall be mixed and heated, and placed in the melted asphalt in the kettle. The ingredients shall be mixed thoroughly with iron stirring rods until all particles of the aggregates are covered with and incorporated in the asphalt, care being taken to prevent burning. After the mastic is mixed it shall be removed from the kettle and poured while hot. It shall be placed in layers not more than ¾ in. thick, the thickness of the layers being gaged by wooden strips held in position by suitable weights. The layers shall lap not less than 6 in. at the joints and shall be brought to the required thickness with wooden spreaders and floats. The top layer shall be finished to the required grade and with a smooth surface. On surfaces steeper than 4½ vertical to 12 horizontal, brick or concrete protection shall be used instead of mastic. As soon as the top layer of the mastic is finished, it shall be given a mopping of hot asphalt sanded to a walking surface while hot.

Discussion

[Chairman B. R. Leffler (N. Y. C.) presented the report and the subject matter in Appendix H on revisions to the Manual was received as information without discussion, following which Appendix B on specifications for waterproofing was presented and the *motion made that it be adopted for inclusion in the Manual.*]

W. L. R. Haines (Penna.): Under asphalt specifications, a ductility at 77° F. of not less than 20 centimeters is given. In recent years it has been possible to obtain asphalt of a higher ductility than that; 25 is quite commonly accepted as a minimum specification, and there has been some argument even for a higher duc-

tility than 25. If I am not mistaken, the Association of State Highway Officials working under the direction of the Bureau of Public Roads adopted a specification for water-proofing asphalt and 25 is specified as the minimum.

There is another question. The statement has frequently been made that coal tar pitch is not as satisfactory a material for bridge water-proofing as asphalt because it becomes brittle at a higher temperature than asphalt, and that it does not have the self-healing properties of asphalt, that is, a membrane made of coal tar pitch will become brittle at a point considerably above 32° F., and if it is subject to flexure while in this condition, it will rupture, and when the temperature again rises, it will heal itself. There is a greater factor of adhesion or cohesion.

G. A. Haggander (C. B. & Q.): Regarding the ductility of 77 deg. F., the American Society of Testing Materials has adopted specifications along these lines, and it specifies ductility of 15 centimeters. We originally recommended 25, but we conferenced with a number of manufacturers and water-proofing experts and found that a ductility of 20 could generally be manufactured without any trouble, while 25 seemed to be a special product, limited to a few manufacturers. In weighing everything that we could get together, we thought 20 would be the highest that we could adopt and get a good deal of competition. We were shown some tests where the ductility changes rapidly in the first few weeks of the life of the asphalt, and it seemed to get down to 20, even though it started at 25 or above. We thought 20 was a stable point, especially when the test was not made immediately after the manufacture. We were not able to come to any conclusion as to coal tar pitch. Quite a few roads are still using it, and they like it rather well. We thought that was a matter of judgment and didn't see any reason for throwing it out.

Mr. Haines: I met the same difficulty in getting a specification of less ductility than 25. Several manufacturers raised the question that it was difficult to obtain an asphalt with a ductility of 25 with the other properties specified. Nevertheless, there were several who did it and there were some manufacturers who had even produced an asphalt with higher ductility. For that reason I feel, speaking for our road and my own personal opinion, that we should insist on a higher ductility, as it is indicative of a better product. There is one other point I neglected to speak about. I notice there is no ductility given at low temperature. In a number of discussions I have had, some with engineers of the Bureau of Public Roads, it seemed important that the ductility at lower temperatures should be specified because some asphalts that show a good ductility at 77 deg. will show little or no ductility at temperatures under 40 deg. I have seen several specifications requiring a ductility as low as 32 deg. I believe it has generally been accepted that it is hardly safe to require a definite ductility at a temperature under 40 deg. but that at 40 deg. an asphalt should show ductility of not less than four to five centimeters with a ductility of 25 at 77 deg.

Mr. Haggander: In our first printed copy we had a ductility at 40 deg. F., but we found that in some of the later specifications it was eliminated and we called in the consulting engineers, testing engineers, and received their opinion on this. They said that the ductility at 40 deg. is difficult to determine and they felt that if the other qualities met the specifications the ductility at 40 deg. would be satisfactory.

[*The motion to adopt Appendix B for inclusion in the Manual was carried,* following which the report in Appendix C on bridge inspection was presented.]

Chairman Leffler: I am going to ask Professor Wilson to give the Association a more detailed statement of the work of this committee. I will add that the Association has contributed financially to the extent of $1,500 to aid this work which is being done in the experimental laboratory at the University. There have been several meetings of the sub-committee at the University, but the real work has been done by Professor Wilson.

Prof. W. M. Wilson (U. of Ill.): The title to this report needs some explanation. The real problem is that of the rolling bascule bridge, which consists of a movable bridge which has a cylindrical shore end, the moving load being counterweighted in such a way that the center of gravity of the whole bridge is at the center of the cylindrical part. The bridge opens and closes by rolling back and forth upon a horizontal plane track. This type of bridge is fundamentally sound and has a number of advantageous points. Unfortunately, a number of these bridges have failed, the cylindrical portion having gone to pieces in service. This investigation was undertaken in the hope of obtaining information on which to base the design of an economic and safe structure.

The problem has been that of the bearing value of a cylinder lying upon a plane surface. By lying upon a plane surface I mean that the axis of the cylinder is parallel to the plane. Because of the difficulty of rolling a large loaded cylinder, the first experimental work was the testing of segments of large cylinders under static load, the assumption being that the smallest load that would produce a permanent deformation, either a flattening of the cylindrical surface or a depression in the plane surface, would be the load which should govern the design.

This report is an abstract of a forthcoming bulletin of the Engineering Experimental Station of the University of Illinois. This bulletin is now in press and we hope to have it issued in about one month. There will be no charge for the bulletin, at least for several months.

At one time the A. R. E. A. specifications for movable bridges stated that in the design of a bascule bridge the load should be equal to 120 times L D, where L is the length of the roller and D is the diameter, both qualities being expressed in inches. Later this was changed to read, "The design load shall equal L times 3200 into the square root of D." As a result of these tests the committee has recommended that, for rolling bascule bridges in which the cylindrical portion is made up of deep cast segments, the design load shall be 500+110 D per linear inch of roller.

So far I have been talking about static tests only. After we had proceeded with the static tests it occurred to us that we might be able to actually roll a loaded cylinder. We were able to roll a cylinder 65 in. in dia. when subjected to a load of 140,000 lb. and we determined the load which would cause a plate to roll out.

Before these tests were made the thickness of the sole plates did not enter into the size of the rollers, although it was the opinion of many engineers that the thickness of a plate did affect the load which caused it to roll out. The diameter of roller used in these tests is not comparable with that which is used on bridges. The largest diameter we were able to use with this machine was 65 in., whereas the bridges had a diameter ranging from 15 or 20 ft. up to 60 ft., but with the diameter of 65 in., we found that a plate 1½ in. thick would withstand three times the load that a plate ⅛ in.

thick would stand. In other words, the thickness of the plate, which had been entirely neglected in the design work, was proved to be one of the most important variables in connection with the design.

Since this report was written we have built a different type of machine in which we can roll segments of cylinders under load. This machine has a capacity to test cylinders having diameter up to 40 ft., and can roll a cylinder of this diameter when subjected to a load of 60,000 lb. We have actually made tests upon cylinders of that diameter, rolling them at the load of 60,000 lb., just 40,000 lb. below the weight of the machine. The sole plate used in this test was a plate 4-in. thick, and we were actually able to roll it out as we would roll pie dough, using a roller 40 ft. in diameter. I say we were able to roll it out in the same sense that you would roll out pie dough.

The University of Illinois is continuing these tests. We have made one series of tests using cylinders 18 ft. in dia., and rolling plates varying from one-half inch up to three inches in thickness. We have made another series of tests using a cylinder 40 ft in diameter and roll plates in varying thickness from 1 in. up to 4 in.

[Appendix C was accepted as information, following which progress reports on specifications for steel highway bridges and on column tests were presented, Dean F. E. Turneaure (U. of Wis.) being called upon to discuss the latter work.]

Dean Turneaure: Three years ago the American Society of Civil Engineers created a committee on steel column research. It was thought that while a good deal of work had already been done, it was desirable for a new committee to investigate all of the data which had been accumulated heretofore. This association had a committee on steel columns which made a number of tests some years ago, but for lack of funds that work was not continued. In view of the organization of the American Society's committee, the committee of this association has not attempted any independent work, but its chairman has met with the American Society committee and given it the benefit of his ideas, and our committee has kept committee XV informed of the progress of the work.

The committee made a progress report which covered a considerable part of what it had in mind. Up to that time all of the work had been confined to a study of existing data. It then became evident that it would be desirable to conduct a few tests, on relatively small columns to give the committee information regarding a possible program of further tests. Consequently a few columns were built and have been tested. They were in part solid rolled columns, in part lattice columns, with lacing of different sizes, and some batten plate columns. They were tested at the University of Wisconsin, and the results will be included in a report which we hope to make next January.

There were two or three kinds of tests made: one in particular was a test made by applying an oblique load; that is to say a load oblique to the axis of the column. The purpose of this test was to determine the strength and effectiveness of the lacing bars or batten plates. We applied a shear up to five per cent of the direct stress, and by using lacing of various sizes we determined the effectiveness of the lacing for this particular set of columns.

In one case we purposely made the lacing quite thin and were able actually to cause a buckling of all of the lacing bars that took the compressive stress, showing exactly what the stress of those particular bars was when attached to the columns in the usual manner.

Not only did these oblique loading tests give us information as to strength, but they also gave us good information as to the rigidity or flexibility of the columns with respect to shearing distortion. Those shearing distortions were measured in a way and showed, as we expected, a greater shearing distortion for laced columns than for the solid rolled columns and still greater distortion for the batten plate columns.

The general results of those tests indicate that the behavior of a column loaded eccentrically follows closely the theoretical results. We also determined by this method the effect of initial crookedness of the columns and have measured with respect to certain groups of columns what the crookedness was when we started to test them.

We also found that lattice columns are much more flexible in the plane of the lacing than they are in a plane at right angles to the lacing. Therefore, if a column is built with the same radius of gyration in the two directions, it will not be as strong in the plane of the lacing at right angles thereto.

Finally, on solid rolled H-columns we found that under these eccentric loads, while the deflection followed closely the theoretical values, the ultimate fiber stress or the maximum fiber stress on the compression side of the column was considerably greater. In other words, when the column bent so that the edge of the column was stressed to the highest degree in compression, the fiber stress ran up very much above the ultimate strength of the material before failure, whereas if the column bent in the direction at right angles to that, so that the extreme fiber stress occurred along the entire width of the flange, as you would naturally load an I-beam, then the maximum fiber stress at failure was only slightly above the yield point strength of the column.

Chairman Leffler: I want to call attention to the significant remark that the Dean made regarding the weakness of lace columns where the radius of gyration is made the same in both directions. We have all been assuming, as designers, that such a column was equally strong in either direction.

[The chairman then presented the remaining subjects and requested Dean Turneaure to discuss the Committee's Abstract of a report by the Railway Board of India on moving loads covered in Appendix D.]

Dean Turneaure: The Railway board report makes use of all the available experiments on impact, including particularly the experiments made by this Association, and attempts to arrive at an impact formula from a theoretical basis in part and in part from the experiments, and it arrives at a formula which is quite a bit lower than the formula used in this country. But they have one advantage in India in the smaller impact blows of their locomotives, and they have another in the definite regulation that no new locomotive can be adopted without first submitting it to the bridge engineer. (Laughter and applause). They seem to have a little better control over the impact blow of the locomotive than appears to be the case in this country. The result of that is a lower impact curve.

It is interesting to note that the theoretical impact formula, worked out quite independently of the work done by this committee, agrees almost exactly with the formula worked out some years ago. In making a report to this convention we did not rely on the theoretical impact formula, but took the results of the tests and produced a formula which was based on the worst results we got.

Chairman Leffler: Showing the wide influence of the early impact experiments made by Dean Turneaure and the committee of this Association, the Railway Board of India republished word for word Bulletin 125 of the Association. Several years ago there was an engineer from the British India Railroad, C. W. Lloyd-Jones, who visited this country and interviewed a number of engineers. Dean Turneaure was one of them, and he went into this matter from the British India standpoint quite thoroughly.

[There being no further discussion the committee was excused.]

Report of the Committee on Rail

With the single exception of the transverse fissure, no subject relating to rails is a source of greater concern at the present time than the battering of the rails at joints. For this reason much interest will be displayed in the report of the Rail Committee on the Cause and Prevention of Rail Battering which takes the form of a compilation of replies to an elaborate questionnaire sent to officers of the railways and the rail mills. Transverse fissures receive attention in three sub-committee reports, including the statistical report of the committee's engineer of tests, a report on the Pennsylvania's investigation of reheated blooms and a study of fissure detectors. Earl Stimson is a new chairman of the committee on Rail but has been a member of the committee for the past three years.

Earl Stimson
Chairman

THE committee presented reports covering the following subjects:

(1) REVISION OF MANUAL

The committee proposed material for Manual revision as follows:

Drilling of Rails—Pending the completion of studies which are being made, the committee is not prepared to recommend drilling for the 150 lb. rail section and therefore recommends that clause (4) under "Drilling of Rails" on page 124 of the Manual be revised to read as follows:

"For standard rails 120 lb. per yard to 140 lb. per yard a 1⅛-in. bolt and a 1⅜-in. bolt hole shall be used."

Revise diagrams shown on page 128 of the Manual, under heading "Standard Locations of Borings for Chemical Analyses and Tensile Test Pieces" to show the outer and middle locations, designated as "O" and "M" positions, respectively, to agree with paragraph 3 (b) of the 1925 Rail Specifications.

Standard Tests for Rail Joints, appearing on pages 133 to 135 of the Manual. The Committee considers this specification obsolete and recommended that it be dropped from the Manual.

The Committee recommended that the Specifications for Medium Carbon Steel Track Bolts with Nuts, appearing on pages 135 to 137 of the Manual, be dropped as obsolete.

Revised rail inspection forms Nos. 401A, 401B and 401C (Exhibits A, B, and C of the committee's report).

Abandonment of rail inspection forms Nos. 401D and 401E as obsolete.

The committee recommended that rail failure form 402-B be revised to include under the caption "Nature of Failure" a column for "Horizontal Fissure" to be located between "Transverse Fissure" and "Broken."

Revision of rail failure form 402-C (Exhibit D of the committee's report).

Revision of transverse fissure rail failure form 402-E (Exhibit E of the report).

Revision of title of form 402-F, "Manufacturing Record of Interior Fissure Rail Heats," to read "Manufacturing Record of Transverse Fissure Rail Heats."

List of definitions. These were given in Appendix A, which is omitted here.

(2) MILL PRACTICE

The committee continued its study of mill practice as affecting the quality of steel rails, reported progress on this subject and called attention to Appendix B, Pennsylvania Railroad report on history of the experimental 100 lb. P. S. Section rail rolled in 1915, reheated blooms vs. direct rolling.

The committee gave careful reconsideration to the 1925 standard specifications for open-hearth carbon steel rails and recommended no change to be made therein.

The committee presented revisions of rail inspection forms Nos. 401-A, 401-B, and 401-C as Exhibits A, B and C, respectively (not shown here). It also recommended the abandonment of rail inspection forms 401-D and 401-E. These forms are now obsolete.

(3) RAIL FAILURES

The committee presented rail failure statistics for the period ending October 31, 1925, as Appendix C, which is abstracted below.

Table 1—Average Failures Per 100 Track Miles

Year	*Years' Service*				
Rolled	*1*	*2*	*3*	*4*	*5*
1908	.....	.....	.....	.....	398.1
1909	.....	.....	.....	224.1	277.8
1910	.....	.....	124.0	152.7	198.5
1911	.....	77.0	104.4	133.3	176.3
1912	28.9	32.1	49.3	78.9	107.1
1913	12.5	25.8	44.8	69.5	91.9
1914	8.2	19.8	32.9	50.9	74.0
1915	8.9	19.0	34.2	53.0	82.4
1916	11.8	29.2	47.7	70.6	105.4
1917	21.6	38.9	66.0	110.5	137.0
1918	8.9	27.6	54.0	92.8	125.4
1919	14.8	39.4	73.7	104.8	115.7
1920	14.2	32.4	63.1	84.5	119.6
1921	10.9	34.9	56.9	70.9	.....
1922	15.9	34.8	55.2	.....	.....
1923	14.3	33.2	.....	.....	.....
1924	14.0	.....	.....	.....	.....

The five-year record of the 1920 rolling is not quite as good as that for the 1919 rolling. It is thought that such slight changes in rates of failure are in some measure due to successive reports not necessarily containing records from the same total number of roads and it is believed that the general downward trend of rate of failure will continue.

For the purpose of securing greater uniformity in reports from the various railroads, the committee presented as an Exhibit D, a recommended revision of rail failures form 402-C.

(4) Transverse Fissures

The committee has given this subject intensive study as outlined in Appendix D. Metallurgical investigation to determine the cause of transverse fissures is in progress. Devices for detecting transverse fissures in track have been investigated by the engineer of tests. The committee has secured an appropriation from the A. R. A. for further development of a device to detect transverse fissures in track.

Transverse fissure statistics have been extended to include all failures from such cause reported up to January 31, 1926. The record now comprises a total of 22,469 transverse fissure rail failures. These failures are now occurring at the rate of nearly 4,000 per year and high rates of failure per year are not confined to the heavier traffic roads.

The committee presents as Appendix E a report on rail batter in collaboration with the Committee on Track. Exhibit H accompanying this report contains valuable information on this important subject.

The committee presents as Appendix F a final report on the welding of bonds.

The committee's recommendations were as follows:

Items No. 1 to 10 inclusive, the changes given under Revision of the Manual.

Items No. 11 and 12, the adoption of the conclusions given in Appendix E.

Item No. 13, the adoption of the recommendation in Appendix F.

Committee—Earl Stimson (U. P.), chairman; Hunter McDonald (N. C. & St. L.), vice-chairman; E. E. Adams (U. P.), J. E. Armstrong (C. P. R.), W. J. Backes (B. & M.), A. F. Blaess (I. C.), F. L. C. Bond (C. N. R.), C. B. Bronson (N. Y. C.), W. C. Cushing (Penna.), J. M. R. Fairbairn (C. P. R.), L. C. Fritch (C. R. I. & P.), E. A. Hadley (M. P.), C. R. Harding (S. P.), L. J. F. Hughes (C. R. I. & P.), John D. Isaacs (S. P.), C. W. Johns (C. & O.), J. deN. Macomb (A. T. & S. F.), R. Montfort (L. & N.), A. W. Newton (C. B. & Q.), W. H. Penfield (C. M. & St. P.), G. J. Ray (D. L. & W.), C. P. VanGundy (B. & O.), F. M. Waring (Penna.), W. P. Wiltsee (N. & W.), Louis Yager (N. P.) and J. B. Young (Reading).

Appendix B—Details of Mill Practice and Manufacture as They Affect Rail Quality

The committee presented as information a Pennsylvania railroad report entitled "History of the Experimental 100-lb. Open Hearth Pennsylvania Specification Section Rail Rolled in 1915—Reheated Blooms vs. Direct Rolling."

The following letter of transmittal accompanying this report outlines the conclusions reached.

W. C. Cushing, chairman, Pennsylvania Railroad Rail committee, to other members of his committee, dated May 19, 1926:

"This comparative trial was determined upon by the offices of the company in 1915, and in order that the members of the committee might have full knowledge of the results of the investigation, R. S. Harden, under the direction of H. C. Crowell, assistant to the chief engineer, was assigned to compile and study all the information available in connection with it.

"The outstanding lesson in this experiment is the improved condition of the interior structure of the steel due to the thermal treatment, thereby lessening the tendency to rail failures of all kinds, included in which are reductions in the percentages of broken rails and transverse fissures.

"In the special examination of Lackawanna heat No. 3186, made by the Altoona laboratory, it is noteworthy that none of the reheated bloom rails which broke showed either transverse fissures or nuclei in the head, while 60 per cent of the direct rolled rails tested broke, showing this type of failure in the process of development. Neither did the reheated bloom rails show any indications of shattering cracks in the head or base portions of the samples, while the direct rolled rails which disclosed fissures under the deep etching, upon examination, showed a considerable number of internal ruptures or shattering cracks in the head portion.

"This has a strong bearing in fact toward the improvement in internal rail structure and lessening of internal stresses and strains by reason of this thermal treatment. These improvements have been brought about without any increase in the value of the physical characteristics measured.

"It is, therefore, an important starting point in the study of rail manufacturing conditions with the view of bringing about, if possible, such change as will help to eliminate the conditions from which the shattered state of the head arrives."

Appendix D—Transverse Fissures

The subcommittee appointed a special committee with instructions to prepare an outline of a suggested metallurgical investigation on the cause of transverse fissures. The engineer of tests of the rail committee was instructed to investigate such transverse fissure detecting devices as might be available.

The result of the investigation of transverse fissure detecting devices was given in an Exhibit F. It covers the various devices available or proposed for the purpose, and it contains a recommendation that the electric detecting device invented by Elmer A. Sperry offers reasonable promise of successful development, and that it be further developed.

As reported to the Rail committee last year, a statement had been compiled comprising 15,357 transverse fissure rail failures, accumulated up to January 31, 1924. This statement has been extended to include January 31, 1926, and now comprises 22,469 transverse fissure rail failures. The gravity of the situation is indicated by the fact that transverse fissure rail failures are now occurring at the rate of nearly 4,000 per year. High rates of failures per year are not confined to the heavier traffic roads.

A revision of form 402-E, "Statement of Transverse Fissue Rail Failures," was submitted for approval which eliminates the columns of calling for traffic data at present required and omits the heading "Kind of Failure," as it is understood that only true transverse fissure rail failures are to be reported thereon.

Appendix E—Cause and Prevention of Rail Battering

The Committee on Rail, in collaboration with the Committee on Track, issued a questionnaire of 31 items to the railways and to members of the Manufacturers' Engineering committee and the replies were presented in Exhibit H which is abstracted below with the exception of Parts I and II embracing the first eight questions which related to the making of investigations and the standardization of terms and methods.

Conclusions

The following conclusions, which have since been approved by the track committee are submitted to the Rail committee for adoption and inclusion in the Manual:

(A) That joint battering cannot be entirely prevented but may be ameliorated. That the most promising sources of

such amelioration are exhaustive studies of mill conditions, track construction and maintenance.

(B) That all other things being equal, evidence indicates rail battering is approximately proportional to the width of the joint gap.

(C) That effective anchorage applied at the time the rail is laid (in both directions on single track) is essential toward the proper preservation of the expansion spaces provided in the original laying of the rail.

(D) That the maintenance of bolt tension adequate but not greatly exceeding that required to produce the maximum strength of the joint is essential toward the maintenance of proper expansion spaces.

It is also recommended that the following terms and methods be standardized by adoption and printing in the Manual:

Joint Gap.—The distance in 64ths of an inch between the ends of contiguous rails measured at a point about 5/8 in. below the top of the rail.

Batter.—The distance in 64ths of an inch between the bottom of a straight edge 12 in. long, applied along the top center line of the rail (with one end coinciding with the end of the rail), and the top of the rail measured at a point ½ in. from the end of the rail.

(A) For welding up, resawing and renewal purposes the batter should be measured with a taper gage.

(B) For statistical purposes the batter should be measured with a micrometer.

The following definitions are recommended for adoption and printing in the Manual:

End Overflow.—The projection into the joint gap of metal at the top of the gage side of the head of the rail brought about by impact of wheels under traffic.

Milling Rail.—The cutting with a milling hob of the ends of the rails to correct roughness and inaccuracies of sawing.

End Chipping.—The loosening of the metal on the top or gage side of the end of a rail subjected to traffic.

This above report was approved by the subcommittee of the Committee on Track as well as by Subcommittee V of the Committee on Rail at their joint meeting held in Chicago on November 15, with the exception that conclusion "B" as shown above is as revised to meet the approval of the Track committee, whereas in the original form it read as follows: "That all other things being equal, rail battering is directly proportional to the width of the joint gap."

Exhibit H

Part III. Cause of Rail Battering

Question 9. Does the tendency toward batter vary with the different weights of rail per yard and how does the tendency operate?

Greater batter with heavier rail	18
Greater batter with lighter rail	1
No difference noted	7

Question 10. Is the batter affected by variations in the chemical content of the rails and how?

Yes	1
Negligibly	3
Decreases with hardness of rail	10

Question 11. Is the batter affected by the position of the rail in the ingot and how?

Yes	2
No	6
Increase toward top of ingot	8

Question 12. What percentage of batter is due to end chipping?

Small percentage	7
25 to 35%	3
50%	4
Very large	2
100%	2

Question 13. What causes end chipping?

End overflow with subsequent expansion	9
End overflow with subsequent contraction	3
Improper expansion allowance	3
Binding of rail ends	2
Cold rolling or end overflow	4
Cold rolling and running of rails, etc	3
Want of ductility	1
Sawing rail with base to saw	1

Question 14. Is end chipping due to any great extent to the quenching by cooling water applied to the hot saws?

No	11
Yes	4

Question 15. Is batter affected by width of joint gap and how?

Batter increases with width of joint gap	27
No effect except when gap is closed	1
Little effect	1

Question 16. Is batter affected by the use of clean, well tamped ballast and how?

Clean, well tampered ballast decreases batter	27

Question 17. Is batter affected by the use of so-called base supported joints and how?

No effect	10
Less batter with base supported joints	7
More batter with base supported joints	6

Question 18. Is batter affected by the use of joint bars in excess of 2 ft. long and a number of bolts in excess of four and how?

Increased	1
Decreased	6
No	7

Question 19. Is batter affected by the lack of contact between underside of head and top of joint bars and how?

Yes—increased	27
Yes, except for base supported joint	1
Yes—decreased	1

Question 20. Is not the presence of the joint, affording three directions in which the metal can flow, the cause of rail batter?

No	3
Yes	20

Question 21. Is batter lessened by the use of suspended and slot spiked joints, rather than hit or miss joints, assuming equally effective rail anchorage in each case?

Yes	9
Yes, if long plates are not used to support rail ends	1
No	14

Question 22. Is batter affected by properly adjusted elevation of outer rail on curves and how?

Yes—reduced	14
No	5
Increased by Excessive superelevation	9

Question 23. Is batter affected by the difference in height of joined rails due to tolerance in rolls and how?

Yes	25
No	3

Question 24. What is the best method of avoiding or removing such difference?

Match rails to within 1/64 in.	1
Match rails	1
Lay consecutive rails with brand on same side	1
Care and selection in laying rail	1
Load and ship rail of the same heat together	1
Load together rails of equal height	1
Do not use base supported joints	1
Hold tolerance to minimum	2
Reduce tolerance	1
Grind rail to level	2
Rigid specifications and inspection	1
Not serious enough to warrant special treatment	1
Believe there is no practical method	3
Proper mill inspection	1

Question 25. Is batter or end chipping produced by fins rolled over on the top of the rail by the cambering rolls?

No	8
Not to any extent	1
Yes	9
Yes, to some extent	2

Question 26. How can these rolled down fins be prevented?

Mill rail ends	2
Mill rail ends and also file in field	1
Remove by hand	1
Saw off fins	1
By careful mill inspection	2
Maintain proper expansion allowance	1
Prevent cambering rolls from reaching ends of rail	1
Place head of rail to saw—Use balanced section rail requiring minimum camber	1

Question 27. Is batter affected by the speed of trains and how?

More batter with slow train movement on curves	7
More batter with fast train movement	16
Yes	11
Not likely	1
Not materially	1

Question 28. Is batter affected by different axle loads and how?

Increases with loads	25
Only as speed varies affects	1
Think not	1

Question 29. How do you explain the fact that with equal chemical, maintenance and traffic conditions and identical rail sections some rail ends batter very little and very slowly, while others batter very rapidly.

Variation in other contributing factors	1
Un-uniform material or treatment in manufacture	1
Unequal chemistry	1
Equal chemical and maintenance conditions at all joints unlikely	7
Variation in design of joints	1
Variation in mill conditions	2
Doubt if generally true	2
Not a fact	1
An unexplainable fact	1

Part IV. The Prevention of Rail Battering

Question 30. Can rail battering be prevented and how?

No. N. C. & St. L.
Only by preventing end overflow. D. & R. G. W.
Yes. By more careful rolling. H. V.
Can be reduced, I believe. B. & O. C. T.
Our experience has not shown how. C. C. & O.

Question 31. Can rail battering be lessened by sawing off the end overflow? What is best method and approximate cost per rail end?

(a)	Yes	16
	No	2
(b)	Sawing	6
	Sawing or burning	1
	Sawing or chipping	2
	Chipping	1
	Filing	1
	Hack saw	1

Question 32. Can rail battering be lessened at all joints by welding up?

Yes	22
No	2

Question 33. Can rail battering be lessened by effective rail anchorage?

Yes	31
No	0

Question 34. Can rail battering be lessened by uniformly sustained bolt tensions?

Yes	29
Only by uniformly sustained joint gaps	1
Not if all bolts tight	1

Question 35. Between what limits (in thousands of pounds) should bolt tensions be kept?

6,000 to 10,000 lb. C., R. I. & P.
8,000 to 18,000 lb. Verona.
10,000 to 15,000 lb. C. B. & Q.; N. C. & St. L.
10,000 lb. N. P.
12,000 to 15,000 lb. U. P.
20,0000 min. for 1-in. bolts. M.-K.-T.
20,000 to 30,000 lb. H. V.
As tight as possible without stretching bolts. C. C. & O.
Approximately one-half the yield point or approximately 35,000 lb. N. & W.

Question 36. What other means of reducing rail battering do you suggest?

Change of joint bar before excessive batter	1
Renew fastenings at least twice during the life of rail	1
Proper maintenance of efficient rail joint	1
Extra surfacing of joints and harder tamping	1
Proper expansion	1
Keep joint gap to a minimum	2
More passes through rolls in mill	1
Improvement in uniformity and quality of rail	1
Endeavor to secure special heat treatment of rails other than now employed	1
Use of rail joint springs with adequate reaction to maintain tension on bolts and keep joints tight	1

Question 37. Please give your views, if you have formed them, as to the necessity and possibility of securing greater uniformity in heat treatment (cooling) of rails as a means of lessening rail batter.

Do not consider practicable	1
Desirable	3

Question 38. What are your views as to the possibility of securing increased resistance, to batter by some process of tempering the ends, which will not produce end chipping?

Not practicable	4
Desirable	2

Question 39. Please give your views as to the necessity and possibility of securing better fit along fishing contacts by reduction in tolerance for rolling rails and joint bars?

Not practicable	3
Not necessary	2
Desirable	3

Appendix F—The Effect of Gas Welding Signal or Propulsion Bonds to Open-Hearth Rail

The committee has made an intensive study of this subject from the following angles:

1. Laboratory experiments of gas welds to the head, base and web of rails. The results of this study were reported as information at the 1926 session of the A. R. E. A. However, we conclude from these experiments that it is inadvisable to weld bonds to other than the head of the rail.

2. From such data as the committee has been able to gather we do not favor the use of gas welded bonds on rail having other than the normal manganese content. A questionnaire was circulated to 46 representative railroads and replies received from 22. The reports show over 1,000,000 bonds applied to the rail head. 871,100 of these are signal and 141,200 are propulsion bonds. They are applied within the limit of the joint bars in *straight-of-way work*, but in *special work* such as around switches, frogs, crossings, structure grounds to rails, and impedance bonds to rail, they are applied without the bar limits.

The reports further show no failures traceable to the use of head-welded bonds, have so far occurred, and some of these bonds have been in service for a period of five or six years, but a majority have been applied within the last three years.

From an analysis of the replies we draw the following:

Conclusion

That, insofar as the standard open-hearth rail is concerned, no detrimental effect results from gas welding signal or propulsion bonds to the outside head of the rail, particularly within the limits of the joint bars.

Recommendation

The committee recommended that the application of welded bonds to the outside head of the rail within the limits of the joint bars for *standard bonding* and outside of joint bars for *special work* where not practicable to apply them within the joint bar limits, be approved as good practice, and this recommendation printed in the Manual.

Discussion

[The report was presented by Chairman Earl Stimson (B. & O.) who asked A. F. Blaess (I. C.), subcommittee chairman, to outline the proposed revisions of the Manual as given in Appendix A. These were all approved without change. Following this C. R. Harding (S. P.), chairman of the Sub-committee on Mill Practice, presented the report on that subject and it was received as information. Chairman Stimson then called for the report on Rail Failures by W. C. Barns, engineer of tests of the committee, and it was received as information. The transverse fissure report was presented by Sub-committee Chairman J. de N. Macomb (A. T. & S. F.) whose outline of the report was followed by its acceptance without discussion. Hunter McDonald (N. C. & St. L.) then presented the report on Rail Battering and submitted the conclusions for

adoption. His motions carried. He then presented the definitions and *moved the approval* of the one for Joint Gap and his motion carried. He then presented the definition for Rail Batter and *moved its adoption.*]

C. W. Baldridge (A. T. & S. F.): The definition on batter is not quite what we should have. The amount of batter, up to some 300ths or 400ths of an inch in most cases, is a matter of wear and is not a matter of batter. That is the troublesome condition we generally understand when we say a battered end rail. There should be a distinction made between what constitutes a battered end rail which is damaged and a worn end rail. There is a lot of difference between a battered end rail, which is damaged, and one which is worn. A battered end rail is better than one worn down.

Mr. McDonald: This question was given considerable attention. It is a fact that the straight edge used by the Santa Fe which has a pointer on a dial is 30 in. long. My investigations led me to believe that I was trying to determine how much the rail was battering and not how much batter was deflecting under the load. A 30-in. straight edge will take into consideration the amount of dip or bending that the rail has been subjected to, which I think is not germane to the subject we are studying. I therefore adopted the length of 12 in.

Mr. Baldridge: That is not the factor which I had in mind. A battered end rail is a rail that has commenced to widen as well as be lower at the top. Every rail wears some at the top and at the ends and unless that rail has commenced to widen somewhat, I don't believe it should be called a battered end rail.

[The motion carried, as did one for the adoption of Paragraph B. Similar action was taken on the definitions following.

Mr. McDonald then gave additional information on the observations which are being made on battered joints on his road, bringing this data up to February 1.

The report on the effect of gas welding signal or propulsion bonds to open hearth rail was presented by Lem Adams (U. P.).]

Mr. Adams: Further study of this subject leads to the following conclusion, that in so far as standard open-hearth rail is concerned, no detrimental effects result from gas welding of signal or propulsion bonds to the outside head of the rail, particularly within the limits of the joint bars.

In view of this conclusion, *I move that the application of welded bonds to the outside head of the rail within the limits of the joint bar for "standard bonding" and outside of joint bars for "special work" where not practicable to apply them within the joint bar limits, be approved as good practice and that this recommendation be printed in the Manual.*

[The motion was carried and the committee was excused.]

Report of Committee on Rules and Organization

The Committee on Rules and Organization has a prosaic task. In addition to formulating general rules for the guidance of employees of the engineering and maintenance of way department, it is charged with the duty of collaborating with the other standing committees in the development of a uniform set of rules for the many specific tasks performed in carrying out the work of the department. In the report presented this year the committtee offered rules governing the operation of motor and hand cars, etc.; the inspection of bridges, trestles and culverts; the conduct of building employees; the supervisor of work equipment, and the care of motor cars. W. C. Barrett has been chairman of the committee for seven years and a member of it for eight years.

W. C. Barrett
Chairman

THE committee presented a report covering: (1) Revision of the Manual (Appendices A, and B); (2) A revision of and additions to the rules for the inspection of bridges, trestles, and culverts, collaborating with the appropriate committees (Appendix C); (3) Additional rules and regulations governing the conduct of employes in the building department, collaborating with the Committee on Buildings (Appendix D); (4) Manual of rules for the guidance of employees in the maintenance of way department (Appendices E and F); and (5) A table of contents and an index covering the Manual of rules for the guidance of employees of the maintenance of way department (Appendix G). It recommended that the revisions of rules 260 to 284 inclusive in Appendices A and C be substituted for those now appearing in the Manual, and the additional rules in Appendices D, E, and F be approved for inclusion in the Manual.

Committee: W. C. Barrett (L. V.), chairman; E. H. Barnhart (B. & O.), vice-chairman; M. M. Backus (I. C.), D. P. Beach (Penna.), Theo. Bloecher, Jr. (B. & O.), R. G. Bowie (C. & W. I.), H. L. Browne (Cons. of Cuba), E. N. Burrows (Cornell U.), P. D. Coons (C. B. & Q.), J. L. Downs (I. C.), J. M. Fair (Penna.), E. F. Gorman (Reading), H. H. Harsh (B. & O.), J. L. Jamieson (C. P. R.), B. R. Kulp (C. & N. W.), W. C. Mack (C. R. I. & P.), W. W. Marshall (M-K-T.), J. A. Peabody (C. & N. W.), H. J. Pfeifer (T. R. R. Assn. of St. L.), R. N. Priest (A. T. & S. F.), J. W. Stevens (N. Y. C.), C. H. Tillett (C. N. R.), R. E. Warden (M. P.), F. B. Wiegand (N. Y. C.), and C. R. Wright (N. Y. C. & St. L.).

Appendix A—Rules for Operation of Motor, Hand, Push and Velocipede Cars

This appendix covers a revision of rules 260 to 284, inclusive, in Supplement to the Manual, bulletin 279. These revisions are the result of collaboration with the Committee on Economics of Railway Labor and were also reported by that committee in line with its assignment. The committee recommended that these

revised rules be approved for printing in the Manual in place of those now appearing.

Appendix B—Rearrangement and Partial Renumbering of Rules

The report contained in this appendix constituted a partial renumbering of rules and changes in topical arrangement in the Manual of 1921 and subsequent supplements thereto in order that the rules might follow a more logical sequence. No new material was offered on this subject.

Appendix C—Rules for the Inspection of Bridges, Trestles, and Culverts

Wooden Structures

2070 (A) The division bridge inspector shall examine all wooden bridges and trestles.

Points to be Examined:

(a) Approaches—for surface and line and ballast section.

(b) Decks—for rails spiked in accordance with standards with full bearing on each tie, particularly where ties are renewed out of face; inside guard rails placed in accordance with standards; guard timber for soundness and projection of guard rail bolts above top of running rail.

(c) All members—boring where it seems necessary in order to determine definitely interior conditions.

(d) Splices.

(e) Bearing at ends of members for decay or crushing.

(f) All members—see that they are in place, straight and sound.

(g) Angle blocks—for breaks or cracks.

(h) Gib plates—noting bearing on timber.

(i) Rods—noting of they are in adjustment.

(j) Bents and trestles—noting if they are plumb and have transverse and longitudinal bracing.

(k) Piles—when used.

(l) All other parts of structure not specifically mentioned in this paragraph.

2071. The division bridge inspector must report any odd sizes of lengths of timber found in the structure which are not standard or any new work which has been done not conforming with standards.

2072. When the adjustment or replacement of a member is necessary, it must be done under the personal supervision of the ..... or his representative.

2073. The division bridge inspector shall examine the property underneath and adjacent to the structure and report any fire hazard, weeds, dead grass, vines, drifts, etc., that should be removed. He must also report the condition of the fire protection equipment.

Steel Structures

2080. The division bridge inspector shall examine all steel structures.

Points to be Examined:

(a) Deck—Size, spacing and depth of ties over supports; uniformity of bearing of ties; condition of timber as to defect and decay; number and size of defective ties, guard timbers, and guard rails; fastenings of ties; fastenings of guard timbers and guard rails; size of tie plates; condition of walks and railings; condition of planking between rails and between tracks; condition of refuge bays; condition of ballasted deck; whether waterproofing is effective or requires repairs.

(b) Fire Protection—Description and condition of fire protection.

(c) Track—Condition of rails, joints, and fastenings; alinement of track and its relation to the steel structure; surface of track on bridge and on approaches; where the track is out of line or surface, the report shall show the location, amount, and probable causes.

(d) Shims and Blocking—Condition of shims and blocking, giving description and location, making sketch if necessary.

(e) Bridge Seats—Condition as to defects and cleanness.

(f) Anchors and Bearings—Whether the superstructure is securely anchored to the masonry; whether bed plates, rollers, and pedestals are clean, in correct position, and have full bearing; whether rollers are operating properly; whether there are any flaws or breaks in bearings.

(g) Expansion—Clearance between expansion ends and masonry on adjoining spans; whether there is any apparent movement of the masonry.

(h) Paint—Condition of paint; date of last painting, number of coats and kind of paint, as stenciled on the bridge; whether spot painting or repainting is necessary.

(i) Straightness and Alinement of Members—Condition of individual members as to bends and kinks; camber of trusses; alinement of trusses, girders, floor members, and towers; adjustment of eye-bars and counters.

(j) Damage from Blows—Parts damaged by blows from equipment, lading or floating objects; location and extent of damage, making sketch to show parts damaged and repairs suggested.

(k) Cracks and Breaks—Cracks and breaks, especially in floor connection angles, hangers, pin plates, fillets of angles of flanges and posts, and in end sections of lower chords or flanges over or near bearings.

(l) Pins, Pin Holes, and Nuts—Condition of pins and pin holes, as to movement and wear; pins should be observed, under traffic if practicable. The report shall give the location of the pins observed, the amount of movement of the pins, and the wear of pins and pin holes if it can be determined, whether pin nuts are tight.

(m) Rivets and Turned Bolts—Location and number of rivets and turned bolts that are loose and of rivets that have badly corroded heads, giving special attention to floor connection.

(n) Corrosion—Condition of members as to loss of section from corrosion, noting extent of such action, with measurements of remaining section if members are badly corroded.

(o) Cleanness—Collection of dirt on horizontal surfaces.

(p) Movable Bridges—

(1) Lubrication—Whether a lubrication chart is posted and the instructions on it are followed; whether moving parts have been kept sufficiently lubricated. They should be observed during operation. The report shall show whether lack of lubrication is due to inattention or to inadequate facilities. If facilities are inadequate, complete information shall be given with recommendation for improvement.

(2) Gears—Condition of gears as to: Accurate meshing, fit on shafts, fit on keys, breaks, flaws, and excessive wear, protection against falling objects, cleanness.

(3) Bearings—Whether bearings have proper linings and good running fit; whether shafting is accurately alined and whether collars and thrust bearings are in adjustment; attachments of caps to bases and of bearings to supports; alinement, fit, and wear of trunnions and trunnion bearings.

(4) Castings—Condition of wedges, sheaves, locking devices, rollers, treads, etc., as to breaks, or flaws which might cause breaks.

(5) Cables—Adjustment of cables as indicated by slackness, inclination of equalizer bars, or uneven seating of spans; condition of cables as to rust and excessive accumulations of hardened grease; broken wires and broken strands; condition as to lubrication; working clearance; end connections and clamps.

(6) Clutches and Brakes—Working condition and cleanness.

(7) Power Equipment—Condition for delivering the necessary power; whether properly maintained.

(8) Mechanical Features—Operating condition; adjustment of balance wheels; adjustment of wedges or other lifting devices; entire turntable of swing bridges; rail locks and signal interlocking connections; navigation lights; clearances through a complete cycle of operation; balance through a complete cycle of operation; safety devices—electrical and mechanical; lightning protection of power plant and superstructure; condition and adjustment of guides, centering devices, buffers, and bridge locks; condition and fastenings of racks, tracks and tread plates.

(9) Counterweights—Condition of counterweights and their supports.

(10) Operating Diagram—Whether an operating diagram is posted.

(11) Record of Openings—Whether a complete record is being kept of bridge openings, vessel movements, and happenings affecting the interests of the railway company.

2081. The inspector shall report indications of overload or failure in any part of the bridge. He shall observe the behavior of the bridge during the passing of live load, if practicable, noting excessive vibration, deflection, and side sway.

2182. Attachments of wires, pipes, etc., that may be harmful to the bridge shall be reported.

Masonry and Composite Structures

2090. The division bridge inspector shall examine all masonry, concrete, and composite structures including ma-

sonry and concrete foundations of all structures.

(A) Points to be Examined:

(a) The inspector shall first examine the structure for any indication of settlement or other movement. This may be shown by inequalities in the line or surface of the track or by improper space between the back walls and the ends of the supported superstructure.

(b) He shall watch the structure under passage of trains to see whether there is any movement in any joints or courses of masonry or any tipping or working of the structure as a whole.

(c) The pedestals and bridge seats shall be examined for indications of crushing or settlement or other movement.

(d) Expansion joints and bearings shall be examined to see that the movement is not restricted.

(e) Investigation shall be made for signs of undue weathering, disintegration, cracks, crushing, leakage, bulging or need of pointing.

(f) A careful inspection shall be made at the water or ground line for disintegration due to the action of water or ice.

(g) The inspection of foundations shall include an examination for indications of scouring or undermining and when necessary, soundings shall be taken for this purpose.

(h) In connection with the inspection of arches and culverts, sufficient examination shall be made to indicate the need for additional protection in the form of paving, inverts, apron walls or curtain walls.

(i) If definite and reliable records are not available, a field examination shall be made to determine the type and physical condition of the foundation.

(j) Soundings shall be taken to determine the relative elevation of the bed of stream and the bottom of the masonry.

(k) Attention shall be given to any signs of failure to arch rings as may be indicated by cracks or a flattening of the arch.

(l) Reinforced concrete structures shall be examined for any indications of leakage or softening of the concrete. Any instances in which the reinforcement is exposed or rust stains appear, shall be reported.

(m) The provisions for drainage shall be examined to see if they function properly.

(B) General:

(a) The inspector shall, so far as possible, obtain the history of any defects in order to determine, if possible, the exact cause.

(b) In calling attention to defects, mention shall be made as to whether these have the appearance of recent development or whether they seem to be of long standing. The inspector shall compare conditions with those recorded from previous inspections and report any change.

(c) In reporting cracks in masonry, the inspector shall state whether they have the appearance of surface checks or cracks which would indicate incipient failure. In the latter case, permanent marks shall be made on either side of the cracks and measurements taken so that developments can be accurately determined.

(d) When signs of settlement or movement are noted, lines and levels shall be run and reference marks established so that subsequent movement can be determined.

Culverts and Pipes

2100. The division bridge inspector shall examine all culverts and pipes.

Points to Be Examined:

(a) General—(1) Openings—noting if they are in good condition, clean and free of all debris; (2) Ends—noting if the water is undercutting or scouring.

(b) Masonry Culverts—(1) Walls and roof—noting cracks, disintegration, crushing, leakage, bulging or need of pointing.

(c) Wooden Box Culvert—(1) Roof and side walls—noting if there is any buckling, and, if size of culvert permits, if all timber is sound.

(d) Pipes—(1) Settlement, cracking, or pulling apart of pipe.

(e) The division bridge inspector shall report if there is need for additional protection in the form of paving, inverts, apron or curtain walls.

Records

2110. The ..... upon receiving reports from the division bridge inspector, after carefully examining same shall have the information entered on a card index file. This index file should have guide cards for each location and class of bridge and sufficient data cards back of each guide card on which to copy essential information from the division inspectors' reports.

2111. The location guide card shall show "location or milepost," division, valuation section and number.

2112. The guide cards for various classes of bridges shall be different colors, as steel, wooden, composite, etc.

2113. The inspection data cards shall show the bridge number, location, date erected, character, etc., and have sufficient space in which to write the important facts shown on inspection forms; one or more cards being used for the bridge as the case may require.

Appendix D—Buildings

This appendix contained 22 additional rules for buildings, which were approved by the Committee on Buildings as satisfactory to it, and which were submitted for printing in the Manual.

Appendix E—Supervisors of Work Equipment

490. Supervisors of work equipment report to and receive instructions from the division engineer.

491. They will be in charge, on their respective divisions, of such work equipment as may be under the general supervision of the division engineer.

492. They must report their movements daily to the division engineer and chief dispatcher.

493. They will be responsible for the operation and maintenance of all equipment while under their charge.

494. They must see that the repairmen are properly equipped with tools and supplies, that they perform their work efficiently and make proper reports.

495. They must make a quarterly inspection of all work equipment, reporting on the prescribed form to the division engineer, stating the condition and when repairs will be necessary.

496. They must make a monthly report of the performance of work equipment under their jurisdiction, giving amount of work accomplished, cost of fuel, lubricants and other supplies necessary to run the machines and cost of repairs.

497. Division engineer must be notified when necessary to take any work equipment out of service. Prompt notice must be given when again ready for service.

498. They will keep daily record of locations of each machine, together with such records of performance as are necessary to make the required reports.

499. They must see that work equipment repairmen and operators make the required reports on the costs of repairs and operation of the machines under their charge.

Work Equipment Repairmen

505. Work equipment repairmen report to and receive instructions from the supervisor of work equipment.

506. They will have immediate charge of helpers, laborers and all other force under them engaged in the maintenance of work equipment.

507. They will keep such records regarding the cost of repairs to work equipment and other roadway machines as the supervisor may direct and make the required reports of work done and of the receipt, distribution and use of material.

508. They will have charge of and be responsible for the proper maintenance of all work equipment and roadway machines on their assigned territory.

509. They must know the exact condition of work equipment and roadway machines under their jurisdiction, making inspection of them at every available opportunity.

510. They will have charge of and be responsible for such tools and material as are necessary for the performance of their work and must know that these are properly used.

511. Work equipment and roadway machines, including motor cars, must not be shipped to the equipment shop for repairs unless repairs are of such nature that they cannot be performed economically in the field.

512. Equipment in unsafe condition must not be permitted to remain in service.

Work Equipment Operators

515. Work equipment operators report to and receive instructions from the supervisor of work equipment.

516. They will have charge of any helpers assigned to their machine.

517. They will make the required reports covering the operation of the machine as the supervisor of work equipment may direct and will forward them as instructed.

518. They must know the exact condition of the ma-

chine under their charge; that it is in proper condition to do the work efficiently, and if, in their judgment, such machine is not performing efficiently, they must notify the supervisor, in detail, wherein such machine is not in condition.

519. They will have charge of such tools and equipment as may be assigned to them and if any such tools are not in proper condition, must notify the supervisor of work equipment.

520. They must not ship machine to shop for repairs except upon proper authority from the supervisor of work equipment, but when such machine is forwarded, they must see that it is properly prepared for safe movement and in case an operator does not accompany the machine, all brass and other valuable parts, easily removable, should be taken off, boxed and shipped separately.

Appendix F—Rules for the Care of Motor Cars

This part of the report contained additional rules for the care of motor cars which was prepared by the Committee on Economics of Railway Labor in line with its assignment. Both the committees have approved these rules and the Committee on Records and Accounts recommended their adoption for inclusion in the Manual.

Appendix G—Table of Contents and Index for Manual of Rules

Appendix G gave a partial table of contents of the rules for the guidance of maintenance employees which the committee recommended. Several subjects were not covered but the table as given was intended to serve as an outline for future work. The preparation of an index was not assigned until too late for the committee to prepare it. The committee said, however, that it believed such an index should be alphabetically arranged and properly cross-referenced in which case it would not be feasible to prepare an index so arranged until page numbers are assigned. For this reason it did not offer an index this year.

Discussion

[The report was presented by Chairman W. C. Barrett (L. V.). The president stated that no further action was necessary on Appendix A. Chairman Barrett's *motion that the revisions and rearrangements covered in Appendix B be approved for publication in the Manual was carried.* E. H. Barnhart, sub-committee chairman presented the matter in Appendix C and *moved that it be substituted for the matter now in the Manual.*]

H. M. Stout (N. P.): I would like to ask the chairman of the committee if the forms and records which they have proposed were devised in collaboration with Committee XI on Records and Accounts.

Chairman Barrett: That committee has been consulted. We did not get its formal approval, although we did get from the chairman the information that it had no objections to the forms and records as we had them.

Mr. Stout: I am not authorized to speak for that Committee XI, but it seems to me this committee has gone beyond its bounds in undertaking to do the work of the Committee on Records and Accounts, both in respect to drawing up and devising a system of records or a system of forms. I recognize that this committee has a peculiar situation to deal with and my attack on their report in this respect is not bile because I am with it. Nevertheless it seems to me that it should secure the consent and approval of Committee XI before publishing it like this in the Manual.

Mr. Barrett: In explanation I will say that the committee went just as far as it possibly could in trying to get formal approval. We tried to get the Committee on Records and Accounts to tell us just how it wanted the forms made out, and I think that for good and sufficient reasons it was not able to do that for us. But the committee did say to us that it had no objections to the forms in order to make the report complete. It seemed to this committee that it was really necessary to have the forms follow the rules so that anyone looking over the rules would be able to know what forms would be necessary, and it is only fair to say that it is not the fault of this committee that those forms were not formally approved by the other committee.

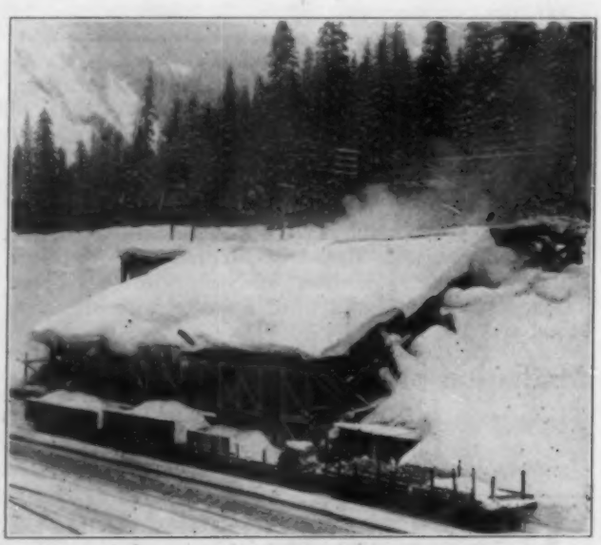
R. H. Ford (C. R. I. & P.): Do I understand from the chairman that in the event they do not now approve the rules that they will not be printed in the new Manual? It was for that reason that they were included in the report.

Mr. Barrett: We wanted to have the rules complete. The committee thought the forms properly belonged to the rules and inasmuch as the rules had been approved by the three other committees directly interested we went ahead with the forms to the best of our ability.

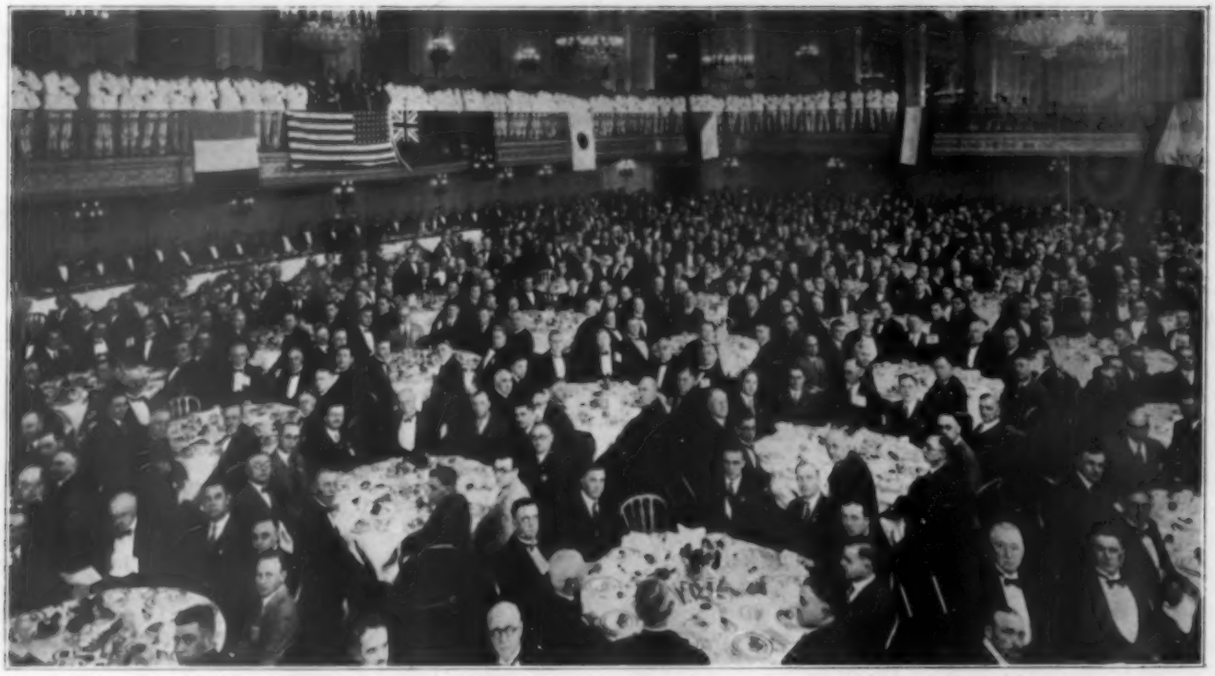
Mr. Ford: I think while it seems technical it is a very important matter. Now we have the facts about this situation. One committee which has authority in directing the work of this respective committee and with whom the other committee was asked to collaborate for some reason did not do it. Something was not done that should have been done and we are faced with this fact that if we adopt this report the Committee on Records and Accounts is practically made a subordinate committee to the Committee on Rules and Organization. I hope the report of that section will not be adopted.

Mr. Barrett: The committee felt that if the convention took the stand that it does we would ask to have the forms eliminated from the report and ask for the approval of the rules leaving the forms to be inserted when they can be properly handled. *I amend the motion.* [The motion as amended was carried.]

[Sub-committee Chairman Barnhart presented the report in Appendix D and moved its adoption, but after some questions were raised as to the distinction between "rules" and "specifications," the committee withdrew the motion and the matter was accepted as information. Mr. Barnhart also presented the Report in Appendix E and his motion for its adoption was carried after some discussion. Appendices F and G were adopted without discussion.]



Snow in British Columbia Imposes Severe Obstacles in Concrete Construction—Aggregate Bins for Concrete Lining Work in the Conneaut Tunnel of the Canadian Pacific



Members of the Association and Their Guests at the Annual Dinner Last Evening

Annual Dinner Breaks All Records for Attendance

More than 1,000 *persons filled the Grand Ball Room to capacity last evening*

THE annual dinner of the American Railway Engineering Association which was held in the Grand Ball Room of the Palmer House, Chicago, last evening established a new record for attendance in the history of that organization. More than 1,000 men were present, filling the room to capacity. A feature of the evening was the presentation of a silver loving cup to President C. F. W. Felt by J. L. Campbell on behalf of the members. Mr. Felt acted as toastmaster, introducing as the first speaker W. G. Bierd, receiver of the Chicago & Alton, who gave an address on the subject, "Is the Cost of Railway Operation Too High?" Following this address Mr. Felt introduced S. E. Winslow, chairman of the United States Board of Mediation, Washington, D. C., who took as his subject "The United States Board of Mediation." The Rev. Stuart C. Barker, minister of St. Andrew's Church, Toronto, Ont., was the third speaker with the topic "Cabbages and Kings."

Mediation of Wage Disputes Under the Labor Act of 1926

By S. E. Winslow
Chairman, United States Board of Mediation and Conciliation

THE Railway Labor act became a law in effect May 20, 1926, and by its passage existing federal laws which might be found in conflict were repealed. Under this law a Board of Mediation, composed of five members, was established. This board began to function in the early part of last July. The work of the board comprehends in a general way the establishment and operation of machinery necessary for the execution of its own prescribed duties and also, by inference at least, a general helpfulness to other agencies which may function under the law. Representatives of a large majority of employee and carrier organizations drafted the bill and presented it to Congress for consideration.

All organizations engaged in interstate commerce, including employees in express companies, sleeping car companies, etc., and any carrier by railroad subject to the Interstate Commerce Act, come under its provisions. The act does not include carriers engaged in strictly intrastate business. Employee and carrier representatives, the joint proponents of the bill known as the Watson-Parker bill, represented to committees of Congress, in hearings and otherwise, their unqualified endorsement of the provisions of the bill and gave assurances of their desire and intention of supporting it fully in spirit and in letter. Congress took them at their word and passed the bill with little or no modifications.

Purposes of the Bill

The fundamental purposes of the bill were, first, to provide methods for settling questions arising between employees and carriers promptly and peaceably through the medium of conferences, adjustment boards, mediation proceedings and arbitrations; second, to provide, in cases of differences not adjusted

by a carrier and its employees, for the appointment of an emergency board by the President, who shall be advised by the Board of Mediation, when in the judgment of such board, a substantial interruption of interstate commerce to a degree such as to deprive any section of the country of its essential transportation service is absolutely threatened. The President may thereupon appoint such number of persons as he considers desirable to serve as an Emergency board. The law also provides that the Emergency board shall investigate promptly the facts of the case and make a report thereon to the President within 30 days from the date of the creation of such board; and further, that for 30 days after the creation of an Emergency board, and for 30 days after the board has made its report to the President no change except by agreement shall be made by the parties to

S. E. Winslow

the controversy in the conditions out of which the differences arose.

The board has no power to establish any findings nor to compel anybody to do anything. Its duty in cases of discussion is to be helpful and, at the request of one or both of those interested or through its proffer of service to make suggestions with a view to bringing about a voluntary agreement between the parties involved. If questions cannot be settled between the carriers and employees in mediation, after having failed in conference or before an adjustment board, a Board of Arbitration of either three or six in number may be established by the parties at the request of the Board of Mediation. If the Arbitration board is three in number each party is to appoint one person and the two so appointed may agree upon a third; or, failing such a choice the Board of Mediation must appoint a third arbitrator. If six in number, each party is to appoint two persons and the four so appointed may agree upon the fifth and sixth arbitrators. Failing such choice the Board of Mediation must appoint the other arbitrators necessary to complete the board.

Progress Has Been Made

Various government boards have been set up from time to time prior to the passage of the Railway Labor act. The Board of Mediation is now established and is functioning and it was the outgrowth of experience which has been marked by disappointments, failures of laws, and other reasons. Nevertheless, on the whole progress has been made under previous laws in the direction of a better understanding of the matters and conditions governing relations between railroad employees and carriers. The proponents of the present law have, through Congress, indicated their purpose to stand by the Railway Labor act and to make the most of it in the interest of fair and harmonious relations. The more voluntary settlements made by carriers and employees, the better.

The obligation of railways and employees to the country is not only economic but moral and human as well and as everybody recognizes and meets these responsibilities, so will the law become effective.

Neither employees nor employers can properly claim exclusive credit for the Watson-Parker bill. They are each entitled to an even share of responsibility for its passage. Censure for failure on the part of either side must inevitably and properly fall on those who fail to support generally the letter of the law and particularly the spirit of it.

The service of mediators must be highly confidential and the attitude of employees and employers in mediation proceedings should be frank and trustful. A breach of confidence on the part of the mediator would be fatal.

The law is not perfect, as may be reasonably expected. If, however, everybody having anything to do with the law or operating under it will make the most of whatever is good and allow experience and time to establish its shortcomings and thereafter, help to develop it, there need be no great difficulty in ultimately providing, through Congress, a reasonably complete and proper working method for the handling of railway labor questions.

When mediations began and parties in interest, including mediators, undertook to proceed under the provisions of the Railway Labor act, nobody knew exactly what should be done other than to try to do the best possible. Possibilities and wise procedure were to be developed. Commercial politics, which have so long been almost a controlling feature attending railroad industrial relations, promptly came into evidence. Happily, they are, apparently, being less and less featured as a possible influence on the minds of mediators or for other purposes.

No Longer Speak of "Fights" and "Disputes"

In the early period of our mediation work the words "fight" and "dispute" were freely used. While there is nothing particularly offensive in the words themselves, it appeared, however, that the users of such terms acted as if their representation of views required a personal manifestation indicative of real, existing, hostile spirit. In order to lift all conferences out of the category and rather unwholesome atmosphere of "economic power" and "numerical strength" discussions, we adopted in our vocabulary as substitutes for "fight" and "dispute" the words "problem" and "discussion." The wisdom of such change of expression became apparent at once, with the gratifying result that the suggestion of hostile contention and bitterness began to disappear and there has developed a habit of discussing problems on their own merits in the interest of all-around fairness as understood and argued by each side according to its own light.

Each case which has come before a mediator has been characterized by its own peculiar features. No two of them have been quite alike and the differences in each instance have naturally brought out different bases of argument. Some of the shortcomings or rather weaknesses of each side have appeared and in many instances have been acknowledged. Consideration has been directed not only to effecting an agreement in the case in hand but also to the in-

terest of desirable developments in the future.

Reference is often made by citizens to "economic power" used by carriers on the one hand and to "numerical power" used by employees on the other in connection with discussions of questions which arise between them. Although such may have been the case in some instances, it is, however, but fair to both to say that in the experience of the Board of Mediation arguments based on either contention have been infrequent.

Settlements of problems have been worked out by employees and carriers through many years and have established what seems to amount to a series of emergency adjustments, which have resulted in an accumulation of apparently endless precedents, neither logically related one to another nor determined with much evidence of foresight as to the insurance of a more orderly and better railroad establishment for the future.

No Manifestion of Bad Spirit

Frequent inquiries recently made have indicated a considerable and widespread interest as to the attitude of employee groups and carrier representatives toward each other in the recently mediated Southeastern Conductors' and Trainmen's case.

It is not proper for the Board of Mediation to disclose to anybody information confidentially given to its mediator representatives in connection with cases, nevertheless I see no harm in stating that during the period while this case was in mediation, there was no manifestation of bad spirit on the part of anybody. Furthermore, at no time did anyone in the interest of any party to the proceedings inquire of or undertake to advise the mediator save through the regularly appointed and recognized representative of each side. All conferences with the mediator were on a high level and were a credit to those who took part.

Our observation thus far seems to indicate pretty generally a waning interest in government ownership of railroads, and a desire to avoid strikes is clearly the wish of everybody.

I believe that the most important fundamental difficulty in handling railroad industrial problems is the all too apparent and overworked lack of confidence one in another and the suspicion incident thereto. The members of the Board of Mediation who have had experience in operating the present law recognize this fact and intend to do whatever they can earnestly and judiciously to bring about the establishment of a respectful and merited mental attitude one toward another. When and if this desirable condition becomes a reality, and there appears no really good reason why it should not, the backbone of acrimonious activities will be broken and the long existing menace to truly intellectual procedure will automatically disappear.

"Are Our Railroads Costing Too Much?"

By W. G. Bierd
Receiver, Chicago & Alton

ASSEMBLED here, we may well say, are the scientific men of the American railways, the railroad engineers. These gentlemen, all of scientific training, are capable of analyzing, thereby learning the needs of the American railroads, and today when we refer to the railroads of this country, we must also consider and give serious thought to other means of inland transportation, because each is so seriously affected by the other that they cannot well be divorced. One is directly competitive with the other. The principal two of these are, first, the railroads; and, second, the motor vehicle and public highway transportation.

W. G. Bierd

The third and less important is transportation by the inland waterways.

Let us briefly review the investments in the two first named transportation systems.

RAILWAYS AND THEIR EQUIPMENT		IMPROVED HIGHWAYS AND MOTOR VEHICLES	
Miles	251,000	Miles	495,000
Locomotives	70,000	Motor Trucks	2,500,000
Freight Cars	2,440,000	Automobiles	17,430,000
Passenger Cars	56,500	Motor Buses	70,000
Rail Motor Cars	500		
Total Units	2,567,000	Total Units	20,000,000
Investment	$25,000,000,000	Investment	$25,000,000,000
Annual Cost	$ 6,310,000,000	Annual Cost	$12,125,000,000
Five Years Ago It Would Have Been:			
Miles	253,000	Miles	370,000
Locomotives	70,600		
Freight Cars	2,400,000	Motor Trucks	1,000,000
Passenger Cars	56,150	Automobiles	8,220,000
Rail Motors	50	Motor Buses	5,000
Total Units	2,526,800	Total Units	9,225,000
Investment	$22,000,000,000	Investment	$13,800,000,000
Annual Cost	$ 6,360,000,000	Annual Cost	$ 6,000,000,000

Twenty-five years ago an inventory for the highways would have been blank so far as present modern highway improvements are concerned. The railways would have shown $10,500,000,000; and the annual cost of railway transportation about $1,500,000,000, or one-twelfth of this country's present-day annual cost of transportation.

Considering these sums so large that they are incomprehensible, great and powerful, almost invincible, as the American people are, these sums mounting up so rapidly as they are, are indeed alarming, even to this great people.

Is the subject of these remarks, therefore, appropriate, and is the American people's transportation costing too much? And in particular are our American railroads' operations costing too much?

I am not subject to alarm. I am not in the slightest degree pessimistic. To the contrary, a great people must expect great results, and great tasks require great men to work out these great problems successfully.

Nevertheless, when we contemplate the enormous growth, the enormous investment and the enormous

cost of operation for the last 25 years, must we not hesitate, must we not begin to take stock of our conditions, to know that our methods are sound? Otherwise, are we not subject to great errors that assuredly threaten danger to the well-being and prosperity of the people?

The American people have been, and still are, passing through a most unusual period, a prosperity, that has never before been known or realized by any people. I fear that this unusual prosperity has resulted in a reckless mode of life and most reckless business methods. Every branch of industry including agriculture and also the American railroads or our transportation systems; every branch of society, those of the great centralized districts, as well as those of the rural areas, have also, hand in hand, set out upon this uncharted sea, practically throwing away both rudder and compass and are drifting with this most extravagant custom of all time.

To my mind it is impossible to continue this for any considerable period of time without inviting and realizing a crisis. Therefore, if these well known facts are worthy of consideration, should not the business man of today begin seriously to consider a change in the method of conducting his affairs?

Our railroads are 100 years old. However, the railroad systems of today are practically the result of efforts of the past 45 to 50 years. But the more striking feature in which lurks the harm, the danger, is that during the past 12 years, or since the world's great upheaval, these most extravagant demands, these most extravagant things, have occurred. We observe that our cost of transportation 25 years ago, was but one-twelfth our present cost of transportation, and subdivided again, one branch of this transportation has more than doubled in the past 7 years. In our railroads is invested about twenty-three billions. In our public highway transportation is invested about twenty-five billions, with an annual cost of eighteen billions. Can the American people support this mode of life, this runaway extravagance, and avoid danger? I think not.

I believe we can safely say that the American railroad mileage, and its facilities, have been essential and necessary up to the present time, but I fear we cannot say, with the same degree of assurance, that our present day costs are sound and can be maintained. Beginning with, and since, federal control of the roads, our cost of maintenance, operation and taxes, has increased well above 100 per cent, whereas the rates of revenue to support these costs have increasd about 52 to 56 per cent.

The roads have weathered this condition because of an unprecedented volume of traffic, but to my mind we have arrived at the danger point, because the costs of maintaining and operating the railroads, including taxes, are still increasing, whereas there is an equal decrease in the rates of income. Therefore, our curves of income and outgo are sharply diverging, one because of the constantly increasing demands of labor and materials, the other by constant demand for decreased rates of carriage.

There is not an adjustment of rates that does not tend downward, whereas to the contrary, every adjustment as to wages and the costs of many commodities is as certainly upward, although these costs are now at the war-peak levels. We, therefore, have but one hope, which is a further increase in volume of business; but certainly that too has reversed itself and we are now on the decline, and a most sharp decline, in comparison with former years.

It is in these three factors that I see our danger, which in my judgment seriously threatens the business stability of this country. The American people, seemingly, during this period of extravagance have lost control of themselves and they are demanding such transportation methods that it seems impossible they can support that for which they are asking.

Public highway transportation, or the motor vehicle, in my judgment, has come to stay, but it is costing the people such a tremendous sum that they are now realizing that they have contracted for something which they cannot support. The greater part of this transportation must be looked upon as a convenience, in fact a pleasure rather than a necessity. The people are already greatly disturbed, indeed they are groaning under the burdensome load, but it is their own and individual doing, therefore they are loath to admit it or depart from it.

On the other hand, essential to their interest as the railroads are, there is a growing demand for a greatly lessened cost of railroad transportation. No matter how persistently the railroad officer may contend for his share, no matter how he shows what his condition is, public opinion which governs public supervision has set in against the railroads, and local trade centers, Chambers of Commerce, business organizations, state commissions, federal commissions and the Congress itself, are demanding such changes or modifications in the rate structures which govern our income, that it will be impossible to resist this movement. The railroads will be compelled to yield to a lessening in their cost of transportation. This is certain and it cannot be stopped, because every controlling power, including the federal government, is demanding decreases in the cost of railroad transportation.

We now witness the next extravagance, the wholly unnecessary expenditure, because a few men organize themselves into a working force and set out to cater to local opinion and local sentiment, making extravagant promises and assertions that a new branch of transportation is necessary. And so we have the movement for a Great Lakes to the Gulf waterway, and from the western shore of the Great Lakes to the Atlantic Ocean by the St. Lawrence waterway; and serious as it seems, I fear the people will be led on into supporting these movements, thus again burdening the people with such taxation and such transportation charges that a further revolt will occur. It is positively certain that these three methods cannot be supported; first, because the traffic is not here; and second, the people cannot bear the cost. All of these conditions are the direct result of the extravagant methods of life and the extravagant method of business of the American people.

The first great alarm, or great demand to change this condition is now coming from the agricultural people. You cannot stop that demand. The President's veto of recent legislation will not stop it. The thirty million people who have allowed themselves to be drawn into this extravagant method are rebelling, because they realize they cannot support the present day conditions.

Let us ask ourselves if there is any other industry in the world so governed, so hampered and so controlled by wholly disinterested persons, without a particle of responsibility as to the welfare or continued existence of such enterprise. The answer is "No." I, therefore, come back to the text of my remarks: "Is the cost of operating our railroads too high?" There can be but one answer and that is "Yes." Therefore, must we not unitedly, determinedly, and definitely join to combat this extravagant control, without responsibility, of the American railroads.

A. R. E. A. Election of Officers

Report of tellers announced at close of Wednesday afternoon session—D. J. Brumley president-elect

IMMEDIATELY prior to the adjournment of the afternoon session yesterday Secretary Fritch read the report of the tellers who had canvassed the ballots for officers as follows:

President, D. J. Brumley, chief engineer, Chicago Terminal Improvements, I. C.

Second Vice-President, Louis Yager, assistant chief engineer, N. P.

Secretary, E. H. Fritch.

Treasurer, George H. Bremner, engineering department, C. B. & Q.

Directors: J. deN. Macomb, office engineer, A. T. & S. F.; A. Montzheimer, chief engineer, E. J. & E.; and J. V. Neubert, engineer maintenance of way, N. Y. C.

Nominating Committee: J. E. Armstrong, assistant engineer, C. P. R.; W. J. Burton, assistant valuation engineer, M. P.; O. F. Dalstrom, bridge engineer, C. & N. W.; C. R. Knowles, superintendent water service, I. C.; and Frank Ringer, chief engineer, M.-K.-T.

In addition, W. D. Faucette, second vice-president, automatically becomes first vice-president.

W. D. Faucette
First Vice-President

D. J. Brumley
President

Louis Yager
Second Vice-President

Daniel Joseph Brumley, President

It is a fact worthy of record that six past presidents of the American Railway Engineering Association, Wallace, Fritch, Downs, Baldwin, Safford and Ray, were, during the period of their administration or at some previous time, members of the official staff of the Illinois Central. To this list must now be added another name, that of Daniel Joseph Brumley.

This recognition comes to Mr. Brumley at an appropriate time in his railway career for, as chief engineer of the Chicago Terminal Improvements of the Illinois Central, he has seen the fulfillment of two important stages in the monumental project in which he has been actively engaged during the past seven years. It is less than a year since the Illinois Central completed an almost entire reconstruction and enlargement of its multiple-track entrance into the city of Chicago and converted its dense high speed suburban traffic from steam to electric operation.

Mr. Brumley has been a member of the A. R. E. A. since March 19, 1906. His participation in committee work covers three years with the Committee on Roadway, 1 year with the Committee on Records and Accounts and 14 years with the Committee on Electricity, of which he was vice-chairman from 1916 to 1925. He was elected a member of the board of direction in 1922 and was advanced to second vice-president in 1925.

Extremely conscientious in his work and conservative in statements, he is not given to expressions of opinion on any subject to which he has not accorded the most exhaustive study, a fact which may be offered in explanation of his infrequent participation in discussions from the floor of the convention. This attitude of mind has made him unwilling to undertake any activity outside of his regular employment until he is satisfied that he can give the project the time and study which he believes that it deserves. This does not mean that he has been remiss in his duties to the various technical and social organizations to which he belongs for he has served as an officer in many of them. He has taken a particular interest in the Ohio Society of Chicago, and the Chicago Section of the Ohio State University Alumni Association as well as the Chicago Engineers' Club, of which he is now president. He has also taken a keen interest in the civic affairs of the community in which he makes his home, Flossmoor, Ill., where he has served as village president since its incorporation in 1925. It is also safe to say that he is one of an extremely small number of members of the American Railway Engineering

Association who has done service as a justice of the peace.

The reasons for his success as a leader in outside activities would seem to lie in a happy faculty for enlisting the enthusiastic support of others in the work to be done. He has a way of asking for help that makes one glad to take part in any project he undertakes, for an unquestioned sincerity of purpose and a kindly but undemonstrative cordiality which he extends to everyone has gained him the respect and genuine affection of all who work with him or for him.

Some men have hobbies that cause them to find pleasure in a fine collection of casting flies, guns or golf clubs. But Mr. Brumley's interests during his leisure hours have found expression in another way. He takes pride in a remarkably complete set of garden tools which includes a wide variety of hoes, rakes and weed pullers, all of which he has learned to manipulate with a high degree of proficiency. However, his interest in gardening is far more than that accorded to a mere pastime, for it has not only borne fruit in the form of a beautiful and productive flower and vegetable garden but also in the authorship of a book on gardening in which he takes a pardonable pride.

Daniel Joseph Brumley was born at Leipsig, Ohio, on March 19, 1865. After attending Ohio Normal School he engaged in teaching and later entered the University of Ohio, from which he graduated in 1895. His first railway experience was gained as an assistant section foreman on the Louisville & Nashville, and except for a few months when he was temporarily employed on other work, he was in the continuous service of that road as assistant engineer, track supervisor and roadmaster until October, 1904. He was then made division engineer of the Indianapolis Southern Railway, now a part of the Illinois Central, and less than a year later he was taken into the parent property as principal assistant engineer at Chicago. From May, 1910, to November, 1913, he was engineer of construction, following which he was engineer of maintenance of way and later assistant chief engineer. In April, 1914, with the inception of federal valuation, he was selected to organize the valuation department of the railroad in the position of valuation engineer and continued in this work until federal control, when he was appointed corporate engineer. On March 1, 1920, upon the outset of active work on the extensive terminal improvements of the Illinois Central in the city of Chicago and vicinity, he was appointed chief engineer, Chicago Terminal Improvements, a newly created position, which he has continued to hold since that time.

American Railway Engineering Association Registration

A TOTAL of 345 members and 100 guests registered at the convention yesterday, bringing the registration of members for the two days to 892 and the guests to 321, a total of 1,213. This compares with a registration for the first two days last year of 783 members and 177 guests, a total of 960. The registration follows:

Members

Abbott, A. T., supt. Iowa Div., C. R. I. & P., Des Moines, Ia.
Adamson, J. H., asst. engr., B. & O., Baltimore, Md.
Alfred, F. H., pres. and gen. mgr., P. M., Detroit, Mich.
Anderson, Arthur, junior engr., N. Y. C., East Cleveland, O.
Andrews, J. T., asst. engr., B. & O., Baltimore, Md.
Armistead, F. W., roadmaster, I. C., Mattoon, Ill.
Armstrong, J. E., asst. engr., Can. Pac., Montreal, Can.
Arthur, G. F., asst. engr., I. C., Chicago.
Bakhshi, S. R., bridge dept., C. B. & Q., Chicago.
Baker, W. E., supvr., Penna, Cleveland, O.
Backes, W. J., engr. m. of w., B. & M., Boston, Mass.
Barrett, P. T., office, engr., C. & W. I., Chicago.
Bassett, J. S., div. engr., M. P., McGehee, Ark.
Bates, F. E., brdg. engr., M. P., St. Louis, Mo.
Bertram, H. A., val. engr., C. C. C. & St. L., Cincinnati, O.
Billman, H. E., pres., Ind. Track Const. Co., St. Louis, Mo.
Blackman, C. H., prin. asst. engr., L. & N., Louisville, Ky.
Bock, E. L., gen. supt., C. & O., Huntington, W. Va.
Bond, L. H., engr. m. of w., I. C., Chicago.
Bousfield, J. C., div. engr., Wabash, Detroit, Mich.
Bradford, A. F., asst. engr., M. P., McGehee, Ark.
Bridgman, J. N., asst. engr., A. T. & S. F., Topeka, Kan.
Brown, H. F., asst. dis. engr., N. P., St. Paul, Minn.
Brown, P. M., instrumentman, M. P., Nevada, Mo.
Bryant, C. T., asst. div. engr., C. C. C. & St. L., Springfield, O.
Burnett, W. S., chief engr. of con., C. C. C. & St. L., Cincinnati, O.
Burt, C. S., supt. ties & treatment, I. C., Memphis, Tenn.
Burt, J. W., div. engr., C. C. C. & St. L., Indianapolis, Ind.
Butterworth, A. S., res. engr., M. P., St. Louis, Mo.
Byers, M. L., chairman, val. com., S. A. L., East Orange, N. J.
Carpenter, R. H., asst. engr., M. P., St. Louis, Mo.
Carter, H. K., asst. div. engr., C. C. C. & St. L., Matoon, Ill.
Causey, W. B., vice-president, M. E. White Co., Chicago.
Chamberlain, O. P., vice-pres., Dolese & Shepard Co., Chicago.
Cherrington, F. W., chief engr., Jennison-Wright Co., Toledo, O.
Chevalier, C. R., asst. engr., M. P., St. Louis, Mo.
Chorley, R. W., mech. insp., Penna., Indianapolis, Ind.
Clarke, H. R., gen. insp. p. w. & s., C. B. & Q., Chicago.
Clift, A. E., senior vice-pres., I. C., Chicago.
Coates, F. J., supvr. track, I. C., Dyresburg, Tenn.
Cook, O. U., insp. engr., Tenn., C. I. & R. Co., Birmingham, Ala.
Cook, C. C., maint. engr., B. & O., Baltimore, Md.
Cooke, C. C., secy., Fritz-Rumer-Cooke Co., Columbus, O.
Copeland, R. D., asst. engr. m. of w., A. A., Owosso, Mich.
Cowsert, J. M., supvr. w. d., M. P., Gorham, Ill.
Craine, Lawrence, asst. engr. val., M. P., St. Louis, Mo.
Cramer, W. N., supvr., I. C., Freeport, Ill.
Crowe, S. N., div. engr., Wabash, Chicago.
Crymes, T. P., Jr., supvr., Y. & M. V., Tutwiler, Miss.
Dalstrom, O. F., engr. of brdg., C. & N. W., Chicago.
Dansey, J. W., asst. engr., A. T. & S. F., Chicago.
Davis, A. L., prin. asst. engr., I. C., Chicago.
Davis, B. V., div. engr., C. & O., Peru, Ind.
Davis, M. B., supvr., I. C., Newton, Ill.
DeLamater, B. E., asst. engr., C. C. C. & St. L., Galion, O.
Delo, C. G., chief engr, C. G. W., Chicago.
Desmond, J. J., roadmaster, I. C., Chicago.
Dickerson, B. S., engr. m. of w., E. I. & T. H., Washington, Ind.
Dickey, H. B., instrumentman, M. P., Nevada, Mo.
Disney, C. P., engr. of bridges, C. N. R., Toronto, Ont., Can.
Dobson, J. F., asst. engr., B. & O., Baltimore, Md.
Doyle, T. L., div. engr., Penna., Grand Rapids, Mich.
Dunn, O. T., asst. engr., I. C., Paducah, Ky.
Eby, C. W., asst. engr., W. C. F. & N., Waterloo, Ia.
Edwards, John, Jr., asst. engr. m. of w. & s., B. & O., Pittsburgh, Pa.
Elliott, Leigh B., div. engr., C. C. C. & St. L., Springfield, O.
Fair, J. M., div. engr., Penna., Philadelphia, Pa.
Farlow, G. B., div. engr., B. & O., Grafton, W. Va.
Faus, H. W., engr. of tests, N. Y. C., New York City.
Fithian, E. B., div. engr., M. P., Wichita, Kan.
Flemming, H. W., div. engr., C. N. R., Hornepayne, Ont., Can.
Friend, H. L., instrumentman, M. P., St. Louis, Mo.
Freeberg, Solomon, instrumentman, M. P., Nevada, Mo.
Fulweiler, W. H., chem. engr., Philadelphia, Pa.
Gamble, J. S., supvr., Wabash, Moberly, Mo.
Gravelle, R. A., asst. engr., C. N., Detroit, Mich.
Graves, J. W., div. engr., Erie, Buffalo, N. Y.
Geis, R. L., asst. engr., C. C. C. & St. L., Springfield, O.
Gibson, Andrew, supt. tim. presvn., N. P., Brainerd, Minn.
Giles, W. H., asst. engr., M. P., St. Louis, Mo.
Gonsar, P. E., master carpenter, Penna., Chambersburg, Pa.
Goos, J. H., insp. engr., G. N., St. Paul, Minn.
Haggander, G. A., brdg. engr. C. B. & Q., Chicago.
Hallihan, J. P., chief engr., Rapid Transit Commission, Detroit, Mich.
Hamilton, G. F., dis. engr., C. B. & Q., Alliance, Neb.
Handsaker, Nelson, asst. engr., N. P., St. Paul, Minn.
Haner, Ernest, asst. engr., M. P., Monroe, La.
Harman, H. H., engr. brdg., B. & L. E., Greenville, Pa.

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Rockenbach, H. R., supvr., Penna., Steubenville, O.
Roussan, A. J., asst. engr., M. P., St. Louis, Mo.
Sackett, H. S., J. D. Lacey & Co., Chicago.
Sandberg, O. C., supt., Wabash, Peru, Ind.
Schnebelen, J. J., asst. engr., M. P., St. Louis, Mo.
Schramke, P. R., Chicago.
Shasteen, C. H., track insp., A. T. & S. F., La Junta, Colo.
Shaw, H. D., chemist, I. C., Chicago.
Signell, L. G., asst. supvr., Penna., Warsaw, Ind.
Spencer, D. R., asst. eng., Wabash, Chicago.
Sullivan, W. W., C. G. W., Chicago.
Taylor, W. S., supt., C. & O., Covington, Ky.
Teague, O. R., S. A. L., Savannah, Ga.
Wagner, R. G., T. & P., Dallas, Tex.
Walker, L. A., asst. engr., Wabash, St. Louis, Mo.
Wallace, E., roadmaster, C. P., Weyburn, Sask.
Wicker, C. S., sales mgr., Buffalo Slag Co., Buffalo, N. Y.
Wilson, W. S., div. engr., Penna., Oil City, Pa.
Wood, E. O., div. engr., Penna., Buffalo, N. Y.
Wolverton, I. M., pres., Mt. Vernon Bridge Co., Mt. Vernon, O.

A Plan for Studying Effects of Swaying Cars on Tracks

MEMBERS of the A. R. E. A. who read the monograph appearing in one of the bulletins about a year ago in the form of an exposition of the physics of swaying cars with particular relation to the influences of the staggering of rail joints will find further interest in the fact that a plan is now on foot for the development of a testing machine by means of which these relationships may be accurately determined. This project has been undertaken by T. H. Symington of Baltimore, Md., who has had a long experience in scientific investigations having to do with car design. Mr. Symington was responsible for the draft gear testing plant at Rochester, N. Y., which was taken over by the government during the period of federal control. He also developed the side frame testing machine installed at Baltimore some years ago for the investigation of the stresses in side frames.

The testing plant which Mr. Symington is now interested in developing is designed to afford not only accurate information concerning the effect of side sway but also data on the effect of longitudinal oscillation or "galloping" and the vertical vibration of the car due to periodic compression of the springs on the vertical reactions of wheels and rails.

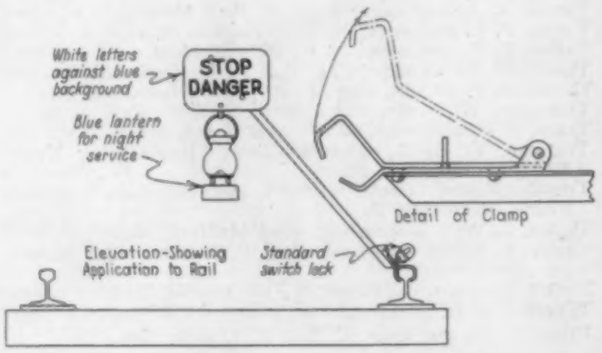
While tests such as he proposes would develop a large amount of information that would be fruitful of improvements in car design, it would also afford an opportunity for obtaining some pertinent facts concerning the effect which the behavior of cars in service imposes on the track structure. In view of this, Mr. Symington believes that the prosecution of an investigation with the aid of testing equipment of the character proposed would afford an unusual opportunity for co-operative work of the A. R. E. A. and the Mechanical Division of the A. R. A. in collaboration with the experiment station of some university co-ordinated with the investigations now in progress such as those at the University of Illinois and Purdue University.

As a means of illustrating what he has in mind, Mr. Symington is displaying a group of interesting drawings in his room—951 Palmer House—where he is demonstrating his plan for carrying out the tests.

A Blue Flag That Locks to the Rail

THE standard code of train rules provides that blue flags, displayed at one or both ends of a car or string of cars, indicate that the cars thus protected must not be coupled to or moved, and this method of protection is often used for boarding or bunk cars housing maintenance forces. To be effective the blue flag must be placed so as to insure its being in position when needed. The common practice has been to make these flags with a stem or standard with a pointed end and to place them by sticking the pointed end into the earth or ballast, with the result that they were easily removed, either accidentally or through carelessness.

About a year ago the Louisville Frog & Switch Company, Louisville, Ky., placed on the market an improved blue flag with a metal plate for the target



The Blue Flag Locked to the Rail

or "flag," with a metal stem having a spring steel clamp at the lower end which permitted it to be attached firmly to the rail, the stem being designed to bring the target near the center of the track. This arrangement eliminated many chances of accidental removal but was not entirely satisfactory since the flag could be removed at will by anyone. To overcome this objection and to furnish a device that would insure the maximum of safety the company has since improved the design by substituting a hinged clamp for attaching to the rail, arranged in such a manner that it may be locked in place by a standard switch lock, thus preventing its removal by any but an employee of the railroad who is authorized to carry a switch key.